ROADS AND STREETS

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Set-Up Where Delivery Is Made by Side-Dump Cars

The Shipment of Road Materials

A Discussion of Rules and Regulations Applying to the Transportation of Construction and Maintenance Materials—Cutting Unloading Costs—Two Demurrage Plans—Savings Effected by Transportation Specialist

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ROAD builders are interested in railroads because of two reasons: first, they are very large taxpayers and, second, they furnish necessary transportation. The United States, with less than 8 per cent of the world's area and less than 6 per cent of the world's population, has 33 per cent of the world's railway mileage, totaling more than 250,000 miles of railway.

Every inhabitant of the United States now requires 35 per cent more freight service than was required in 1911. In other words, in 1911 the railroads carried 2,667 tons one mile for each inhabitant, while in 1928 the railroads carried 3,607 tons one mile for each inhabitant—man, woman and child. No small amount, variously estimated at from 8 to 12 per cent, of this increase is due directly to materials used in building and maintaining roads. While the total revenue tons carried on railroads has increased 45 per cent since 1911, and the total wages paid to employees has increased 142 per cent, the increase in number of men employed is only 4 per cent, thereby indicating the great increase in efficient handling. The railway taxes have increased in the same period 295 per cent, so that at the present time 6.37 per cent of all operating revenues is paid out in taxes. The transportation systems are interested, therefore, not only in securing additional business when roads are built, but also in seeing that this expenditure of taxes is made in the most efficient manner possible.

Items of Cost.—Inasmuch as transportation charges, freight rates, unloading costs, demurrage, side tracks, etc., average about 10 per cent of the total cost of a new road and about 25 per cent of the cost of maintenance on old roads, contractors and county road superintendents should investigate these costs as well as the costs of material, machinery, labor, etc. The freight is by far the largest part of this cost. The rates are fairly definite, as the present scale, agreed upon by the producers and transportation companies in this territory, runs from 12 ct. a ton-mile, with a minimum of 60 ct. per ton, to 1 ct. a ton-mile for 100 miles. The rate per ton-mile is reduced rapidly after the first 5 miles. For a 35-mile haul, the rate is 2 ct. per ton-mile, and for a 55-mile haul, the rate is 1½ ct. per ton-mile. As stated before, for a 100-mile haul, the rate is 1 ct. a ton-mile.

However, it does not necessarily follow that these rates cannot and will not be changed by some transportation companies, if you can show them that they will be in a position to secure an enormous increase in tonnage by a slight freight-rate reduction; a tonnage otherwise lost to them. There is, of course, a minimum rate below which they cannot go and still make a profit and if it is necessary for them to quote such a low rate or lose the business, then it would be better for them to lose the business entirely. The traffic manager of the transportation line or lines concerned should be consulted and all the facts explained to him. He will always cooperate with you to the fullest extent of his ability.

Another big item is the unloading cost from cars. This has been estimated by various contractors as from 10 to 20 ct. per ton. When cars are unloaded by a clam, there must be laborers in the cars to clean the cars and still there is material wasted. When bottom-dump cars are used, labor is also required and material wasted.

Some of the transportation companies

have been experimenting during the past few years with a completely-side-dump car. These cars, either electrically or air-operated, dump the entire load without any labor by the contractor. The contractor saves all unloading labor costs and has no losses of material.

A side track frequently costs from $1,000 to $2,000. The general rule that is followed by transportation lines is for the entire cost of the side track to be assessed against the contractor; but sometimes, if there is a big tonnage to move and the transportation company has no other costs, the transportation company will bear either a part or all of that cost. If the side-dump cars, referred to above, are used, then this material can frequently be dumped off of the main line and the only side track that is necessary is for the cement cars, so that a saving of from $500 to $1,500 can be effected.

Demurrage.—Demurrage is not as costly as it is aggravating. The main point to remember about demurrage is that either of two plans may be used.

The first is known as the straight plan of demurrage. By this plan, each car handled is considered as a unit. You either do or do not owe demurrage on the car. The advantages of this plan are that 48 hours' free time must be allowed on each car, exclusive of time lost by weather interference. Where there is weather interference, claim must be made in writing to the carrier within 30 days after the demurrage bill is rendered.

Additional free time is allowed when cars are bunched by the act or neglect of the carrier. Bunching means that cars arrive at the destination in different order or numbers than shipped. If you had three cars shipped from one destination on one day, two cars the next day and one car the next day and all cars were tendered you the same day, by paying the bill and filing claim with 30 days, you would be allowed two days' free time on three cars, three days' free time on two cars and four days' free time on the single car. If shippers would familiarize themselves with this bunching provision, they would be able to save a great many of their demurrage bills.

Additional free time is also allowed on account of delayed or improper notice by the railroad company, account of improper tender or shipments and delays caused by U. S. Customs. This straight plan of demurrage, as it is known, is used by the shippers and consignees who only ship or receive occasional cars.

The second plan is known as the average agreement. An agreement is entered into between the railroad and the customer, and if required the transportation company can insist on the customer filing a satisfactory bond for the fulfilment of the agreement. A separate account is maintained for cars received and cars forwarded. Cars held for reconsignment, diversion and reshipment, cars in transit and other cars on which only 24 hours' free time is allowed cannot be included in the average agreement.

On all cars handled on the average agreement and released within 24 hours after the first 7:00 a. m., one credit is allowed to the customer. On all cars released after 24 hours, but before 48 hours, neither a credit nor debit is given. On each car released after the 48 hours of free time, one debit per car per day is charged for four days. After a car has acquired four debits, a charge, known as an arbitrary, is made of $5 per car per day, or fraction thereof, for each day, including Sundays and legal holidays. Credits earned will be used to offset debits accruing. The account is handled by calendar months, no debits or credits being carried forward from month to month. At the end of the month, the customer will pay the transportation company $2 for each net debit. If there are more credits than debits, no refund is made by the transportation company. In other words, the big advantage is that the customer gets credit for unloading equipment promptly. The disadvantages are that no allowances will be made for either weather interference or for bunching, as in the straight plan.

The plans are optional with the customer. The straight plan is used unless the customer requests the transportation company to use the average agreement, but otherwise the transportation company has no preference, feeling that under the average-agreement plan cars are unloaded and released much quicker than under the straight plan.

When the electrical or air-controlled side-dump cars are used for handling aggregate, these cars are dumped immediately on arrival at the set-up so that all demurrage is eliminated as cars are released immediately. Special stress is being laid by highway departments and engineering schools on the use of washed aggregates for road maintenance because of the lower maintenance costs secured. Only in exceptional cases can local deposits furnish the right kind of materials. The savings effected by the use of side-dump cars will offset to a considerable extent the additional expenses incurred in using washed aggregates. The maintenance cost over a perid of years will more than offset the remainder of the additional cost. In other words, the best material will be the cheapest in the long run.

All lines of business are progressing rapidly in this country because the men at the head are devoting money, time and attention in attempting to develop more efficient methods of performing their work in a more satisfactory manner. It is not enough that costs be reduced. Better results must be obtained at the same time or the reduction of costs is useless. All persons interested in road building—road schools, highway departments, machinery manufacturers, contractors and others—are giving serious consideration to this problem of better roads at lower costs. The transportation companies are helping all they can.

A practical suggestion is that every business, city, county or state highway department and contractor have one man in the organization specialize on transportation rates and costs. If this is done and the proper contracts are made by this man with the transportation companies, you will find that a great deal of money and inconvenience will be saved to all concerned.

Acknowledgment.—The foregoing is an abstract of a paper presented at the 16th annual Purdue Road School.

Credit Practice Stabilization in Highway Construction

Extension to the highway construction industry of the credit stabilization procedure now being adopted in the building industry was one of the major subjects up for discussion at the annual spring meeting of the Executive Board of the Associated General Contractors of America.

The contractors' association maintains that the highway construction industry has long suffered from the over-expansion of contractors, resulting in unsound competitive conditions that have tended to bankrupt the entire industry while preventing the rendering of proper service to the public. The new move for the stabilization of credit practices is designed to set up and maintain standards of business procedure which would aid in preventing contractors from defaulting on highway projects and would eliminate the consequent delays and losses to the public.

Other features of the program of the association discussed by the executive board at Washington, D. C., April 28, concerned the adoption of prequalification procedure by public bodies whereby the qualifications of a contractor may be determined before he is asked to submit bids, the move to list the past performance records of all contractors in the country through the Bureau of Contract Information, Inc., the progress being made in checking the day labor activities of public bodies and the extension of the accident prevention campaign of the Associated General Contractors.

The board also was called upon to lay down policies for the guidance of the many credit bureaus in the building industry which are rapidly being established in response to the joint program of the contractors' organization and the National Builders' Supply Association.

Retread Construction in New York

Some Experiences with a Cheap Type of Construction for Secondary Roads—Methods, Quantities and Costs—Surface Has Given Satisfactory Service

By GUY W. PINCK

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THREE or four years ago the department found it necessary to construct a road to its highway repair shop and, having very little money, it was necessary to construct it as cheaply as possible. Locally, we have a stone sold by the Solvay Process Co. known as "run-of-crusher," which consists largely of twos, some ones and some dust. This stone is largely the residue from their stone used in chemical manufacture, and in order to dispose of it at that time they sold it for 35 ct. a ton.

This stone was used in the construction of this highway and was spread out to a depth of about 4 in. and given a very liberal soaking of surface treatment tar. After it had set or dried out, it was given another application. This pavement, to everybody's surprise, stood up successfully, and, so far as this section of the state is concerned, was the original piece of so-called "retread."

Somewhere in the west, in Ohio, I believe, practically the same thing was tried, but somebody discovered that the material could be mixed with a grader and last year in this district we built 10 miles of it.

Cheap Top Needed.—The reconstruction of state highways in the state of New York has reached an acute situation. At the present rate of reconstruction it is impossible to reconstruct all the highways that need it each year, simply because there is not sufficient money. The highways, as we reconstruct them today, are a very expensive affair and naturally the main lines receive first consideration.

We have in this district several hundred miles of what might be called secondary state highways—that is, those that lie in the outlying districts and have comparatively light traffic; but they have to be maintained and, when worn out, have to be rebuilt.

I have been searching very extensively for some time to find a cheap top which could be used for this purpose and I believe now that we have secured it in this so-called "retread."

Retread in Onondaga County.—In Onondaga County in 1929 we rebuilt what was originally a waterbound highway 14 ft. wide and 4.52 miles in length, and in Oswego County we rebuilt what was originally a bituminous macadam highway 12 ft. wide and 4.6 miles in length. In rebuilding we widened these roads to 18 ft. and obtained an excellent top, which is from 2 to 2½ in. thick, and which cost in place on the first job 38.4 ct. a square yard, or $4,058 a mile, and on the second job 48.8 ct. a square yard or $4,327 a mile. The difference in cost is accounted for by the difference in the cost of stone; also, on the first job the weather was good and on the second we lost several days due to rain and snow.

The force required on the road to build this new top is 1 foreman, 1 roller man, 1 grader operator and 7 laborers, and this force should build at least one mile per week. Of course any multiple of this unit will necessarily increase the speed of construction. This force does not include that which furnishes the stone, but only the force of men used on the road itself.

On the first job mentioned, the stone was hauled a distance of 15 miles direct from the quarry and therefore we did not have to unload it from railroad cars. On the second job the stone was unloaded from cars.

This new top is a mechanical mix, but is not mixed in the mixer but on the road surface by a grader, preferably a power grader.

The surface of the original pavement should not be disturbed except that it should be fairly clean; but a small amount of dirt does not seem to do any harm to the mix. It is desirable, however, to patch any holes or weak spots which may be in the original pavement.

Methods and Quantities.—For a pavement 18 ft. wide, which is the standard width for this type of road at the present time, it will require approximately 750 tons of No. 2 stone—that is, stone from ¾ to 1½ in. in size—to the mile. This is placed best with a spreader box so as to secure a uniform distribution. This is spread in one thick windrow and then leveled and spread so as to cover the surface of the road to a width of 17 ft. with a power grader. The stone should be kept at least 8 in. from the shoulder line to prevent dirt being mixed with it. Then pour bituminous material "T" cold application on the loose stone at the rate of 0.4 to 0.5 gal. per square yard. The exact grade of bituminous material to use will depend upon the weather. The hotter the weather the stiffer or harder the grade of tar that may be used. A grade of tar should be used that is just fluid but will not set up stiff inside of two or three days. After the loose stone has had the first application of bituminous material, immediately start the power grader turning the stone and tar over into windrows, making a cut of 4 to 5 ft. in width. The grader blade should be set approximately ½ in. above the surface of the old pavement at an angle of approximately 35 deg. Keep the blade of the grader full of material at all times and the rolling action ahead of the blade will be very similar to the mixing action of a concrete mixer. Turning the windrow over is continuous until all the stone is uniformly coated with tar. This may require 7 to 9 times to each windrow. Care should be taken at all times to keep stone away from the shoulders.

After the stone and tar are thoroughly mixed, level the mix to approximately the road surface and leave until the next day. After being allowed to set over night give a second application of approximately 0.4 gal. of tar per square yard of slightly heavier material than used the first time. This should be applied hot and should be spread uniformly, immediately followed by the grader turning it over as in the first instance. This should be continued until it is apparent that no further mixing of stone is possible. It is then spread by the grader and planed to the finished road surface. This is an important operation in securing a good riding road, and it is surprising what a fine road surface may be obtained by this method. It may be necessary to move a small amount of mixture with a wheelbarrow. Two or three men will be sufficient because the amount required to fill up any depressions which the grader will be unable to handle will be very small.

When the surface is satisfactory, start the rolling with a 10-ton roller, the same as you would for a regular waterbound or bituminous macadam highway. Keep the wheels damp to prevent picking up tar. All the time the roller is working, the grader should be kept at work, planing off the high spots and carrying this surplus material planed off into the low spots; in other words, truing up the surface. It may seem to some of you that rolling and grading at the same time is a very peculiar situation, but I can assure you that it works. The rolling is continued until all the voids are removed as far as possible and then 12 lb. per square yard of No. 1 or No. 1a stone is spread uniformly over the surface and rolled and broomed in to fill all remaining voids. The No. 1a stone is to be preferred. This is a stone about the size of small pea. If the mix weaves under

the roller, suspend rolling for a time to allow the bituminous material to set.

After the mix has been allowed to set for two or three days, or until hard, a final application of surface treatment tar is given. This consists of 0.4 gal. per square yard and is given a further cover of 12 to 15 lb. of No. 1 or No. 1a stone and rolled. This application should be as heavy a tar as can be handled in this manner and should be spread hot.

Cost.—The 9.14 miles built in this district this year comprise a total of 91,097 square yards and the total cost was $39,509.65, or an average of $4,327 per mile, or 43.4 ct. per square yard.

While this was built with state forces, using state equipment, nothing was given to the job free of charge. Our trucks were charged against the job at the rate of $30 a day and a pro rata rental was charged for the use of grader and other equipment. Of course the payroll took care of itself as a direct charge.

Incidentally, on the first job the entire pavement was laid in two weeks. I have discovered that what governs the speed of this type of reconstruction is the ability to furnish the stone required.

To date these pavements have been very satisfactory. They have a non-skid surface and I believe they are going to give a great many years of satisfactory service.

Acknowledgment. — The foregoing paper was presented at the Syracuse meeting of Highway Officials of the North Atlantic States.

Uniform Street and Highway Traffic Statistics Needed

EFFECTIVE handling of the highway traffic and congestion problem depends in large measure on the collection, compilation and practical analysis of uniform and standardized accident and traffic statistics by the different states.

This is the belief expressed by Dr. Julius H. Parmelee, Director of the Bureau of Railway Economics, at Washington, Chairman of the Statistics Committee of the National Conference on Street and Highway Safety, and prominent as an economist and statistician in the transportation field.

While not specifically urging a standard statistical form for collecting and reporting accident and other traffic data, Dr. Parmelee pointed out that effective steps toward meeting the problem as a whole must be based upon statistics which are comparable in nature and generally similar in classification and grouping.

He said:

"In proposing traffic remedies or in devising regulations and restrictions, we must first crystallize in the minds of the public the magnitude and complexity of the problem.

"It avails little to propose a remedy or a regulation if at the same time we do not make clear and unmistakable the necessity for such a measure. This can be accomplished in the most effective way through the channel of uniform statistics. To my mind they offer the means for comparable study and for scientific approach to the whole traffic congestion and accident problem."

Dr. Parmelee pointed out that the country as a whole is not sufficiently fortified as to data on traffic accidents —their types, causes and frequency. He asserted that these factors should be measured in specific and comparable statistical terms.

He added:

"Some agency in every state should be clothed with authority to receive accident and traffic reports, and to compile and coordinate them. Reasonable uniformity in tabulating and reporting the figures from these reports is essential.

"Many things are to be learned of the congestion and accident problem through such statistics. First, there is the factor of road and lighting conditions; Second, there is the type and condition of the car; Third, the element of age, experience and physical condition of the driver, and last, the primary cause of the accident.

"Information of this nature will assist the highway authorities in every state and municipality in definitely putting their finger on the most frequent causes of accidents, and will aid more quickly and effectively to devise remedies."

Dr. Parmelee expressed the belief that the people of the country will realize the serious aspect of the congestion and accident problem only when it is put before them clearly in statistical terms.

Among the factors susceptible to concrete analysis in the traffic and accident problem, Dr. Parmelee pointed to recklessness of motorists and carelessness of pedestrians. More than 700,000 persons are being injured in traffic accidents each year, he continued, but the country has no comprehensive grasp as to the magnitude or frequency of each direct or contributing cause.

He added:

"Traffic and accident statistics of this nature can be made the basis of safety education in the schools, and educational work among drivers and pedestrians. If safety education is to accomplish its best results, we must know the scope and magnitude of each primary cause of congestion and accidents.

"It is entirely likely that a study of traffic rule violations from the notations on the records of drivers' licenses will reveal that a small part of the licensed drivers—possibly from two to five per cent—are habitual and reckless violators of traffic and safety rules, and that possibly three-fourths of the drivers of the country have no violations noted on their records.

"The accident problem then would be clearly one of dealing effectively with a small part of the total number of persons who are driving automobiles, and responsible for the reckless driving factor.

"It is difficult indeed to say what proportion of the drivers of automobiles are responsible for reckless driving accidents until we are in possession of dependable and comparable statistics on this point."

Road Exhibition to Be Held in October

Delegrates from fifty-six countries will have an opportunity to study the best products of American highway machinery manufacturers at an international road exhibition to be held in Washington Oct. 7-10, 1930. The exhibiton will be held by the American Road Builders' Association simultaneously with the sixth international road congress.

Inasmuch as the United States produces for domestic use and export more road building machinery and equipment than any other nation, foreign delegations will welcome this opportunity to learn what is new in the industry. The congress program will give much space to the progressive ideas and methods of American engineers. Oddly enough, this nation, which leads the world in improved roads, is entertaining the international road congress this year for the first time.

The exposition will be held in Washington Auditorium. Outdoor space nearby will also be used for exhibits and a demonstration of road building machines under working conditions will be staged.

In addition to an estimated 400 American manufacturers who will have equipment in the exhibit, the manufacturers from all other countries are urged to send exhibits, so that both the exposition and the congress may be truly representative. Exhibits from outside the United States will be shipped and returned in bond, thus avoiding duty fees. Invitations to participate are being transmitted to all countries through the foreign service of the State Department and the Department of Commerce. The Bureau of Public Roads will have an educational exhibit, representing the United States government.

Protection of Roads and Bridges Against Stream Erosion

Review of Available Methods of Protection—Experience of an Indiana County in Protecting an Important Road—Creosoted Piling and Stone Walls and Paving Provide a Satisfactory Solution—Need Felt for More Adequate Stream Legislation

By JOHN L. STEWART
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EROSION has caused up to the present time more than $10,000,000 worth of damage to the farm land in the United States, and deposition of the dirt, stone, gravel, etc., from this erosion on other land has caused more than $3,000,000 worth of damage. The U. S. Department of Agriculture is now carrying on actual work throughout the United States to stop erosion and damage to the farm land. The method most commonly employed is the benching method.

No figures are available at this time from the Bureau of Public Roads with reference to the amount of damage caused to roads and bridges in the United States by erosion, but I am sure it would run well into the millions. The Department of Agriculture does, however, publish a bulletin which deals with the selection of bridge sites with reference to erosion.

Before going into the matter of protection against stream erosion let us consider some of the causes for stream erosion and the conditions which now exist along the streams. The natural tendency of water is to flow in a straight line. The stream could easily be made to flow on long, easy curves if sufficient waterway were given to the stream and if it were not obstructed by drift, growing trees or the many other things which tend to deflect the current from its natural course.

Unfortunately for us, many of our roads were laid out or constructed along the banks of small streams and rivers in the early history of our state. This was due, of course, to the lack of funds and modern machinery to construct grades equal to those already available along the streams without any great expenditure of money. Now that these roads are located as they are with reference to the streams it is necessary to protect the banks to keep them from washing the road and otherwise rendering them unfit for traffic. Wherever it is possible without excessive damage to adjoining property, the most economical solution is to move the road to a safe location away from the stream. However, in a large number of cases it is not possible to do this, as villages and towns have already been built along the highway and to do so would inconvenience those whom the road was intended to serve.

A great number of different types of protection are now in general use in this country. One of them is the retard method. In this very practical and economical method, the stream is made to deposit earth and silt at the proper location. These retards are usually constructed of steel posts covered with wire mesh in fence fashion, set at right angles to the bank to be protected, and securely anchored by wire cables. The downstream side is then banked with brush and trees are anchored to the retard to catch the silt.

Concrete mattresses constructed by fastening together slabs of concrete, making a flexible mat, were used by the Miami Conservancy District in the protection of river banks in their flood control work. This type of protection deserves worthy mention, but is somewhat expensive to construct.

Stone mattresses constructed by the use of a layer of stone from 12 to 18 in. thick between two layers of wire mesh securely fastened together at intervals not exceeding from 3 to 4 ft., are a very desirable type of protection, with flexibility and a tendency to catch silt. They are economical to construct where local stone is available.

Pile dikes are very effective for the training of a stream and the prevention of erosion.

Stone baskets, well constructed, are an excellent substitute for piles where the conditions are such that piles cannot be driven.

Bank Protection Formed of Creosoted Piling and Stone Wall and Mats

We are many times asked the question, "What is the cause of most of the failures in bridges?" I think I can safely say that 90 per cent of the structures which I have had to rebuild have failed in the substructure due to erosion in the stream bed.

Many of the older types of bridges were built with shallow foundations carried down in many cases not more than a foot or two below the stream bed, and many of these bridges must be protected if we expect them to continue in service. Probably the most economical and permanent type of protection in this case is to drive a row of interlocking steel sheet piling between that portion to be protected and the stream. The cavity between the piles and abutment or wing is then filled with concrete. This method is not practicable in many cases, how-

ever, as there is not always sufficient headroom under the bridge to permit the use of pile-driving machinery.

When steel sheet piles cannot be used for protection, the next best solution is the concrete curtain wall. It should be carried down to a sufficient depth below the stream bed to make sure that it is well below future erosion. The cost of the sheet piles which we used last year on Big Cedar Creek protection in Franklin County was $1.00 per lin. ft., the piles being 14 ft. in length and approximately 12 in. in width. The cost of $1.00 per lin. ft. included the cost of driving. Concrete used to fill the space between piles and concrete wall cost $12.00 per cubic yard in place.

The following method was used in protection of the east bank of Johnsons Ford Creek in Franklin County, along which one of the more important country roads was located. Complete plans and specifications were ordered for the protection of the creek bank, including the rebuilding of the road where it had been washed away completely or in part, and an appropriation for the same was made by the county council. The first step was to change the alignment and lay the road back as far as possible from the stream, and to replace the short, abrupt turns with long, easy curves. Soundings were taken in the stream bed at the proper locations as determined by cross-section so as to give room for the protection, including the proper slope to the roadway. It was found that certain portions of the stream bed could be penetrated with piling to a depth of 10 ft., while in other portions apparently solid stone ledges were protruding from the surface. It was then decided to use creosoted cypress piling where it could be driven on the side of the protection next to the stream. This is shown in one of the accompanying illustrations.

These piles were ordered 14 ft. long and 8 in. in diameter at the small end, treated with 12 lb. of creosote per cubic foot. The piles were driven to a depth of 10 ft., with the remaining 4-ft. section extending above the stream bed to serve as protection. The piles were driven to a line parallel to the centerline of the road. A pile cap which would give the greatest protection to the piles was used. A portable driver with swinging leads was chosen for the job. This permitted us to move easily and quickly and to keep all of the machinery at the top of the bank and out of the way of the stream. When the piles had been driven, two layers of galvanized wire mesh were securely fastened to the back of the piles with long iron staples, to retain the remaining part of the protection. This wire mesh was composed of No. 9 wire, 6 in. center to center, both ways, and the wire was covered with a 2-oz. coat of spelter. The next step was to lay up a dry stone wall just back of the piles and wire mesh. This wall was constructed of one-man stone, 2 ft. thick, laid up within 18 in. of the tops of the piles, this space being left to take care of the stone mats to be placed on the slopes.

The cost of these piles, 14 ft. in length, including driving, was 90 ct. per foot, and the cost of the stone retaining wall was $2.00 per cubic yard of stone used. The galvanized wire mesh, 55 in. wide, cost 17 ct. per lin. ft.

After the work described had been completed, the banks were cut or filled to a 1½:1 slope to receive the stone mats, as shown on the picture. The loose earth fills were then compacted as much as possible with hand tamps and the entire surface was covered with two layers of galvanized wire mesh (same as used before) securely wired together to form the bottom of the mat. The wires were placed at 4-ft. intervals in both directions and made sufficiently long to extend up through the stone mat so that the wire mesh at the top and bottom of the stone mat could be fastened together. The stone composing the mat was placed either in single or paved fashion to a depth of 18 in. The two top layers of wire mesh were then placed and securely fastened with the tie wires previously placed. The cost of the stone mat was $1.60 per square yard.

Stone-Basket Protection

Stone-basket protection was used where the stream bed consisted of ledge rock and where piles could not be driven. The stone baskets answer the purpose of both the piles and the stone retaining wall. The stone baskets were formed by two layers of woven-wire mesh, circular in shape and 5 ft. in diameter. The bottoms of the baskets were sloped so that they would tilt about 1 ft. in the total height of 55 in. The baskets were completely filled with hand-laid one-man stone. One single layer of wire mesh formed the top and bottom of several baskets and was securely fastened.

The method of constructing stone mats, sloping of banks, etc., was the same as specified in the protection where the creosoted piles were used.

More adequate laws should be placed upon our statute books providing for the maintenance of the streams, such as changing of the channel, removal or planting of trees and the construction of adequate protection wherever roads or bridges are affected or where the stream forms the boundary line between land owners. This would be the economical solution of the problem, and but few of the large and more expensive forms of protection would be necessary.

In constructing new bridges much consideration should be given to the sub-foundation. If the structure is of any size, and even though the strata which are to be penetrated show sufficient bearing values to withstand the weight of the structure, piles should be driven—at least on the stream side of the abutment and wings where erosion is likely to occur. On small bridges the more economical solution is to resort to invert paving with secondary walls at each end of the invert, and carried down to the bottom of the abutment foundations.

There is no magic formula which can bring about the control of the stream. Such control can be accomplished only through the application of tried and practical methods, based on sound and scientifically correct principles, under the direction of experienced engineers. Whether to design a mattress, retard, jetty or other structure for any particular place depends on the condition at that particular location.

Acknowledgment.—This paper was presented at the annual Purdue Road School.

Maintenance of Asphalt Pavements

Methods and Costs Based on a Study of 300 Improvements Totaling 1,800,000 Sq. Yds. in Columbus, O.

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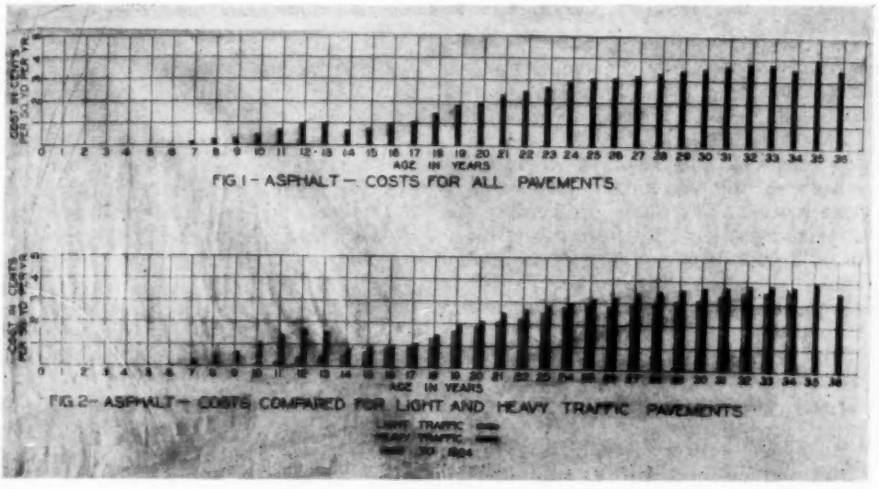
Chief Engineer, Department of Public Service, Columbus, O.

NOTWITHSTANDING the importance and magnitude of the pavement repair problem, it has not been given the study and analysis that has characterized construction. Considerable research has been done, and is still being done, to determine improved methods of design and construction, but very little study has been made of the wear and deterioration in pavements, and very little accurate data published on repair costs. There are, to be sure, reports on repair costs from many cities, but the figures given are misleading, because they do not take into consideration the volume and character of traffic carried or the age of the pavements. At Columbus, O., very complete records have been kept for many years in the repair of asphalt pavements. The accompanying interesting summary of these records was given in a paper presented before the Engineers Club of Philadelphia by Mr. R. H. Simpson.

The maintenance problem has developed in magnitude and importance along with the development of the motor vehicle. At the beginning of the present century, pavements were used almost exclusively by horse drawn vehicles. Now a census will show that more than 99 per cent of traffic is carried by motor cars. It should be noted, also, that where formerly the vehicle was propelled by an exterior force, now it is self propelled by the thrust or grip of the tires against the surface. Instead of blows from iron shod hoofs, our pavements are subjected to the abrasive action of self propelled vehicles. This thrust exerted against the pavement by the driving wheels of a motor car, especially where there is some dirt on the surface, results in a grinding action which will abrade the surface. The variation in speed; the sudden stopping and starting of cars; all contribute to this wear. The results from one vehicle are negligible but from the movement of several million cars are very noticeable. When we know that many thoroughfares carry a traffic of five million, or more, cars in a year, we can realize why these pavements show signs of distress after a few years' service. Just as the constant dropping of water will wear away stone, so the incessant stream of self propelled vericles will eventually wear any pavement surface.

Influences Affecting Repairs.—The repair cost of any pavement is influenced, to a large degree, by the traffic conditions, and any study of the subject should give consideration to this influence. For instance, the main and secondary thoroughfares in the City of Columbus, Ohio, represent 21 per cent of the paved mileage in the city and carry 81 per cent of the total traffic movement. An analysis of repair costs for the year 1928 shows that the pavements on these same thoroughfares absorbed 62 per cent of such costs. In other words, three-fifths of the maintenance costs were expended on one-fifth of the paved mileage, due, very largely, to the volume of traffic carried.



Figs. 1 and 2—Repair Costs on All Asphalt Pavements in Columbus; and a Comparison of the Costs for Light and Heavy Traffic Pavements

The repair costs of any pavement are also influenced by its age. Obviously, a group of pavements from 15 to 20 years old will cost more to maintain than a group from one to five years old. As a matter of fact the 20 year old pavements, in Columbus, cost about four times as much to maintain as those that are ten years old, so that, unless we know the age of a pavement and something of the traffic it carries, the repair cost does not tell us much. There are other factors, of course, that influence the cost of repairs, such as the width of the pavement, the presence of street railway tracks, etc.

Now let us understand clearly what is meant by maintenance and repair. In some cities and highway organizations, resurfacing of old pavements is classified as maintenance, because, perhaps, the work is paid for from maintenance and repair funds. I do not believe this classification is correct. A complete new surface is a new pavement and should be considered as such. The repair of a pavement consists of reconstructing such areas that have become broken or disintegrated, as will keep the pavement in a serviceable condition for use. When the pavement is so badly broken up, disintegrated or so uneven as to justify a new surface, the record should show it as a new pavement.

It is proposed in this paper to give some definite data on the cost of maintaining asphalt pavements. It will be given in terms of the age of the pavements, and the analysis will show costs compared for traffic conditions. It is well to keep in mind that the figures given, and conclusions drawn, are based on a study of some 300 improvements totaling 1,800,000 sq. yd. of sheet asphalt pavements laid in Columbus, O.

Prior to the year 1900 these asphalt pavements were laid on a 6 in. natural cement concrete base. Subsequent to 1900 a portland cement concrete base 6 in. in thickness has been used. About 200,000 sq. yd. of old pavements have been resurfaced with asphalt, in most cases a binder course being used to bring the old pavement to a proper crown. The sheet asphalt type has been used almost exclusively, consisting of a 1½ in. of wearing surface laid over 1½ in. of binder.

Repair Methods.—Practically all of the repair has been done by the "cut-out" method. Surface heaters have been used only in connection with building up settlements. An air compressor

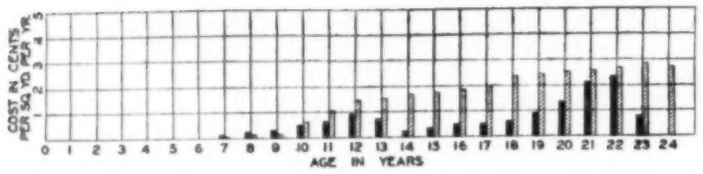


FIG 3-ASPHALT-COST COMPARED FOR PAVEMENTS LAID PRIOR AND SUBSEQUENT TO 1900

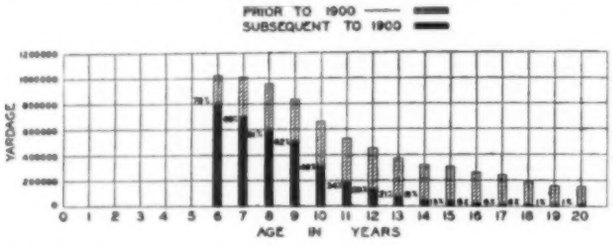


FIG 4-YARDAGE WITHOUT MAINTENANCE COMPARED TO TOTAL ASPHALT YARDAGE

Figs. 3 and 4—Comparison of Repair Cost of All Pavements Laid Prior to 1910 with Those Laid Subsequent to That Year; Also Yardage Requiring No Maintenance, Compared with Total Yardages at Various Ages

is used to cut away the old pavement, the edges of the batch being trimmed and painted with liquid asphalt. Prior to the year 1907 the repairs were made by contract, the repaved area being measured and payments made on a unit price basis. Since 1907, when the city installed a plant, the work has been done by city forces. The organization consists of an engineer-in-charge, a foreman and crew at the plant, and a foreman and crew on the street. The plant is equipped with tanks for storage of asphalt; heating kettles; sand dryer; storage bins and scales for weighing all material; and a motor driven pug mill for mixing same. The dryer is equipped with automatic stokers, coal being used for fuel. Dump trucks are employed to haul the mixture to the street, which is laid and raked in the usual manner. A 10-ton tandem roller is used to compress the asphalt.

Cost Records.—The maintenance of all pavements, in Columbus, has always been under the direction of the chief engineer of the Service Department, and a record of the repair costs has been kept for all improvements constructed since 1888. The work of tabulating and classifying the figures has been completed for some 300 improvements, totaling 1,800,000 sq. yd. As repairs are made the repaired areas on each improvement are measured and recorded, but the unit price to be applied to these measurements is not determined until the end of the season's work. The total expense of the year, including labor, material, supplies, repairs to equipment and plant, a charge for the use of plant, superintendence, etc., is then applied to the total repair yardage, which gives a unit cost to apply to the repairs of each pavement. This gives a repair cost for each improvement that is not influenced by the location of the pavement or its distance from the plant. A more rational comparison between pavements is thus obtained than if the actual cost of each particular improvement is used. At the end of the year the costs for all pavements are computed and recorded on cards prepared for this purpose. There is a card for each improvement, the construction data being on one side and the maintenance data on the other.

The maintenance data consists of the area of the improvement; the area repaired each year; the repair cost each year; the unit cost in terms of total area; the cost per yard per year; and the total cost to date or accumulated cost. The cost per yard per year is really the service test of a pavement and gives a more rational comparison between two or more pavements than if the actual cost at each age period is used, as the latter is usually erratic, being influenced by the shortage of repair funds in some years. The cost per yard per year is the average yearly cost of repairs for the age period under consideration. It is obtained by dividing the total cost of repairs for the given number of years by the area of the improvement and then dividing this quotient by the number of years. For example the total yardage of all asphalt pavements that have been in service ten years is 660,027 and the total expenditures for repairs on these pavements during this ten year period was $33,044.00. By dividing this sum by the number of yards and then by ten, we get $0.005 as the cost year yard per year for 10-year-old pavements. This method of analyzing the repair costs was worked out by the writer a few years ago, as it seemed to be the only way the data could be assembled to give any rational comparisons. It should be understood that it is not the actual cost for any one of the years under consideration, but the average yearly cost for the period. The records of all the improvements show that during some years, and occasionally two or three years in succession, no repairs were made, but, by using the average cost per year, as outlined, a rational comparison is possible. It should be stated that the record does not include any repairs during the first five years, this being the period of guarantee. It is, however, a rare case where more than nominal repairs are required during this period, and for a large majority of the improvements no repairs are needed.

This method of averaging the repair costs also minimizes, if it does not entirely eliminate, the influence of fluctuating prices. For instance, the 10-year-old pavements mentioned are made up of improvements completed in 1888 and most of the following years, up to 1915, and the repair costs are the average of expenditures made from 1888 to 1925 or when the last pavement was ten years old, so that a disturbance in price levels, such as was produced by the world war, has very little effect on the results.

In the manner outlined above the repair costs of all asphalt pavements have been calculated, analyzed and tabulated and the results shown on the charts herein.

Figure 1 shows, graphically, the repair costs of all asphalt pavements in the city for all ages from 1 to 36 years. It is made up from the costs of about 300 improvements, and is the average cost without considering the influence of traffic. It will be noted that, except for a marked increase in cost from the 10th to the 13th year, followed by lower cost for two years, the cost increases somewhat uniformly with the age. The increase is more rapid, however from

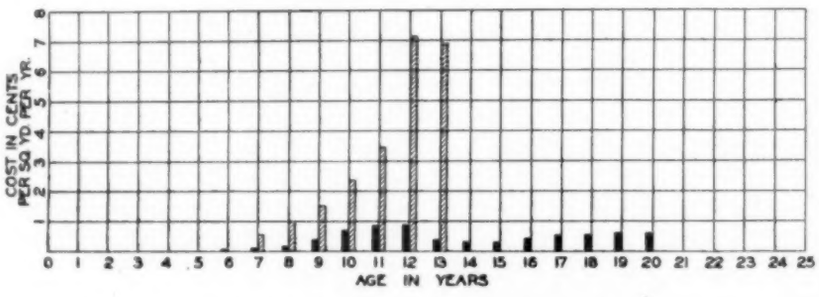


FIG 5-COST COMPARED ON STREETS WITH AND WITHOUT RAILWAY TRACKS

THOROUGHFARES WITH STREET RAILWAY TRACKS
THOROUGHFARES WITHOUT STREET RAILWAY TRACKS

Fig. 5—Comparison of Repair Costs on Streets with and without Street Railway Tracks

the 15th to the 25th year than for any 10-year period.

In Fig. 2 there is shown a comparison of the cost of repair of light and heavy traffic pavements. It will be noted that the costs for the light traffic pavements increase rather uniformly up to about the 17th year, after which the increase is more rapid. The heavy traffic pavements, however, show a marked increase in cost from the 9th to the 12th year. From the 14th to the 18th year, the cost is less than at the 12th year age, but it increases again somewhat uniformly up to the 13th year. It is interesting to note that while there is a marked difference in repair costs of light and heavy traffic pavements, during the first 13 years, there is very little difference after this age, but as would naturally be expected, the cost of the latter is in excess of the former at all ages.

Fig. 3 shows a comparison of repair costs of all pavements laid prior to 1900 with those laid subsequent thereto. It will be observed that with the former the cost increases with the age at a fairly uniform rate, while the latter shows a marked increase in cost from the tenth to the 12th year, followed by a lower cost for a few years, with another maximum at the 22d year. This diagram indicates a comparatively heavy maintenance period for modern pavements at approximately 10 or 11-year cycles, the cost increasing with each cycle. It also shows, clearly, that the modern asphalt pavement, subject to modern traffic, is being maintained at a lower cost than those constructed at the earlier periods. A study of the repair data disclosed the fact that a large number of pavements, considering each improvement a separate unit, have been in service for many years before requiring any expenditures for repairs. As would be expected, these are the lighter traffic pavements. For instance, of the 140 improvements, with a yardage of 660,000, that have been in service for 10 years, 90, comprising a yardage of 323,000, were in service for the 10-year period before requiring any maintenance. This represents 49 per cent of the yardage of 10-year old pavements. It is clear, therefore, that the entire cost of repair for the pavements of this age has been expended on approximately one-third of the improvements and one-half of the yardage. Of the expenditures made, a large percentage has been on pavements where the traffic has been confined to narrow lanes. Figure 4 shows, graphically, the yardage requiring no maintenance, compared with the total yardage at various ages. As would be expected the percentage decreases very rapidly with the increase in age.

Figure 5 gives a comparison of repair costs of pavements on thoroughfares with street railway tracks with pavements on other thoroughfares with comparable traffic. These costs include only that portion of the pavement outside the limits of the car track, as the street railway is obligated to pave this area. While the record is for a comparatively short period, the comparison is striking and shows clearly the effect on repair cost when street railway movement forces a large part of the motor traffic to the sides. The mere presence of street railway tracks in city streets seems to have a tendency to cause the vehicle traffic to confine itself to fixed lanes, which increases the wear and adds largely to the maintenance cost. It will be noted that on thoroughfares without car tracks, the cost increases with the age of the pavement, and that although the tenth, eleventh and twelfth are years of peak prices, the increase for the entire period is somewhat uniform. After passing this peak, the repairs on the thoroughfares without tracks are but little more than for light traffic pavements, indicating that even when traffic is large in volume the maintenance cost is moderate, when conditions are such that it can spread out over the entire surface of a pavement and not be confined to one path.

Critical Period.—The diagrams showing repair costs for heavy traffic pavements indicate a pronounced rise in cost during the earlier age periods. The exact age at which this rise occurs on any particular individual pavement is no doubt influenced by a number of factors, such as sub-soil conditions, construction details and traffic carried, and will vary in different localities. On the average of the pavements under consideration it has occurred from the 10th to the 12th year after construction. This period of high maintenance is not common to all pavements, but occurs on most of those subjected to heavy traffic and on some with light traffic. On account of the fact that this period of abnormal maintenance is not common to all pavements, and that its occurrence is uncertain, this period may be called the critical age in the life of pavements. They must pass this period successfully, by reason of light traffic or other favorable conditions, or they may develop a weakness before this time, by reason of some abnormal condition, but the diagrams seem to indicate that defects either in sub-base, foundation or wearing surface, necessarily do not develop until this age period is reached.

As indicated by the diagrams, the average heavy traffic pavement, after passing this critical period, continues to render service at a moderate cost of repair for another period of from 10 to 12 years, after which the cost reaches a new and higher maximum. The important fact derived from these data is that the repair cost of asphalt pavements is moderate at all ages, even those 30 to 35 years of age. On pavements constructed subsequent to 1900 it may be expressed in terms of cost per mile for a roadway 18 ft. in width, as follows: At 6 years of age approximately $7 per mile per year; at 15 years of age $80 per mile per year; and at 25 years of age $200 per mile per year. Our oldest asphalt pavement, constructed in 1888, has cost 4 ct. per yard per year during the 41 years of its life, and expressed in terms of an 18 ft. road, is $422 per mile per year, which is a remarkable record.

It should be understood that the repair costs shown herein, cover the maintenance of all asphalt pavements in the city. It includes all those constructed during the last decade of the 19th century as well as those in more recent years; those with a foundation of natural cement, as well as those with the modern Portland Cement base. It also includes about 200,000 sq. yd. of asphalt surface laid over old boulder and worn out brick pavements. In other words these are average figures and represent average results obtained from various types of construction and under such traffic conditions as have been common to our American cities during the past 40 years.

Acknowledgment.—The foregoing is an abstract of a paper presented before the Engineers Club of Philadelphia.

A. R. B. A. Meets in May

The annual meeting of the American Road Builders' Association will be held in Washington, Thursday, May 15, 1930, followed by the meetings of the City Officials' Division and the County Highway Officials' Division on Friday, May 16.

The regular annual meeting of the association will be held at 3 p. m., at the offices of the association, 914 National Press Bldg.

The officers and directors elected at the recent convention in Atlantic City will be installed at this meeting; and the reports of the president, the treasurer, the engineer-director and the board of directors of the association and of the presidents of the various divisions will be received and such other business transacted as may seem necessary.

The annual president's dinner of the association will be held Thursday evening, at 7 p. m., at the Willard Hotel.

The regular annual meeting of the City Officials' Division and the County Highway Officials' Division will be held Friday morning, May 16, at 11 a. m., at the offices of the association. At these meetings will be installed the officers of the Division elected at the recent meeting in Atlantic City; and the reports of the board of directors and of the officers whose terms expire at this meeting will also be received and any other necessary business transacted.

Some General Principles of Motor Vehicle Taxation

A Brief Statement of a Point of View Toward Some of the General Questions Involved in Motor Taxation

By JAMES W. MARTIN

Director Bureau of Business Research, University of Kentucky, Lexington, Ky.

This article was written primarily to form a basis for discussion by members of the committee appointed by the National Tax Association to study motor vehicle taxation, but is presented here in hope that others interested in the subject may forward criticisms to the chairman of the committee, the writer of this summary.

THE whole field of motor vehicle taxation may be conceived as involving two distinct aspects: (a) special taxation for highways, and (b) general taxation for miscellaneous governmental purposes. In the United States, in many instances, these two aspects are only vaguely, or not at all, distinguished in practice; but there does seem to be a tendency in recent legislation to draw the line between them.

Gasoline Tax.—The application of the first, the special taxation of motor vehicles for highway purposes, should be regarded as a sort of rental required by the state for the highway which it provides the motor transportation industry. It is as though the state owned a railroad right-of-way and road bed and rented this property to privately-owned railroad companies, apportioning the charge on the basis of the use of the facilities, or the potential use, or both actual and potential use. The state in this country actually provides the motor vehicle operator with a highway, an essential to the successful operation of his automobiles or trucks, and collects remuneration for the service in the form of special taxes.

Generally speaking, the particular taxes used for this purpose in the United States are two: (a) the motor vehicle registration license, which has developed over a period of nearly 30 years, and (b) the motor fuels tax, which has been employed here for slightly more than 10 years. The former is usually designed to take account of possible road use. That is, it is based on the notion that the motor operator should pay for the destructiveness to the highway which his vehicle will probably occasion. Particularly in recent years, it has come to be important also because of the fact that it imposes a charge against the motor owner who uses the vehicle only occasionally but at the same time that many others are doing so. This special charge would not be adequately met if imposed on actual highway use, owing to the fact that road service is more expensive at "peak-load" periods. The second type of impost, the gas tax, is peculiarly adapted to levying a charge in proportion to the amount a vehicle uses the roads. Fuel consumption is small when the road is little used and greater when it is generously used by the motor vehicle.

In general, the gas tax, more effectively than any other one means, meters highway service to the motor vehicle operator. The most important measures of highway consumption are: (a) amount a vehicle is run, (b) speed at which the automobile is operated, (c) weight of the car, and (d) character of tire equipment. The gas tax takes some account of all of these factors and hence should and does occupy a preeminent place in special highway taxation in this country.

Registration License.—However, it is important to point out that the gas tax takes inadequate account of some of the factors of road destructiveness enumerated above. The fuels tax reflects the speed at which a car is operated only to the extent that it is driven faster than it was designed to run, while in general any increase in speed is likely to result in increased wear and tear on the roads, at least on certain types of roads. For instance, the typical automobile passenger car does not consume more fuel per mile when running at a speed of 35 miles an hour than when running at 20 miles per hour, although, particularly on low class roads, the wear on the highway is considerably greater at the former than at the latter rate of speed. Failure to take account of differences in the weights of various vehicles is even more clear-cut than short-coming in reflecting rate of speed. The 6-ton truck may be many times as destructive to the highway as the 3-ton truck, and yet fuel consumption differs by only 25 or 50 per cent. That means obviously that weight, though a condition of gas consumption, is not at all adequately reflected in the amount of fuel consumed. Most important of all is the failure of the fuels tax to take due account of differences in tire equipment. The 3-ton truck, for example, may effect little wear and tear on certain types of highways if equipped with pneumatic tires, while it is extraordinarily disastrous to the same road if fitted with solid rubber tires. Indeed, the average destructiveness seems to be multiplied by about three if a vehicle is equipped with solid rather than pneumatic tires.

As a result of these short-comings in the gas tax as a sole criterion of road use it appears to be necessary to employ a form of taxation which can give due consideration to these omitted, or partly omitted, factors involved in metering road service. The solution which is suggested and which, to a certain extent, the several states have applied is found in the use of registration taxes. If such a tax be wisely employed it appears possible to off-set the weakness of the gas tax in each of the principal respects mentioned, except in the matter of speed. That means clearly that the most important elements of road use inadequately measured by the fuels tax can be reached by means of the license. (Thus far our knowledge of the relation of speed to road wear is probably inadequate to justify the employment of that as a primary consideration even if an objective vehicle factor reflecting it were available.)

If the consideration of differences in weight is to be accounted for by means of a registration license it will be necessary for the charge on large vehicles to be greater than that on smaller cars by more than the amount of the increased destructiveness. The reason for this is clearly shown in the following example: In a given state, let it be assumed that a 4-ton truck (gross weight) will use 700 gal. of gasoline on the average and that the tax is levied at the rate of 3 ct. a gallon. Suppose, too, that in the particular state it is estimated that a truck with a gross weight of 8 tons, having an average gasoline consumption of 1,050 gal., 50 per cent higher, will be about two and two-fifths as destructive on the average roads as the smaller truck. If the registration tax is $22 on the light truck and two and two-fifths as much on the heavy one, the total tax—gasoline plus registration—will be $43 on

the former and $84.30 on the latter. But that means that the tax on the heavy car is less than twice as great as that on the light one—not two and two-fifths as much. If it is to be two and two-fifths as much, the license charge must be increased to $71.70, roughly $72. In general, the gasoline tax increases less rapidly, as the size of the vehicle becomes greater, than relative destructiveness of their vehicles on the highways, the registration tax must be more steeply graduated than merely sufficient to equal the increase in wear and tear on the highways as the size of the vehicle increases.[1]

The same principle applies in dealing with the question of differences in tire equipment as illustrated in the following example: The light truck referred to in the previous paragraph may be equipped with pneumatic or with solid tires. If, using pneumatic tires, the tax is $22, as suggested above, a registration charge three times as heavy on the same vehicle when fitted with solid tires would result in a total tax burden—gasoline plus license—in the one case of $43, and in the other of $89.10, even if a 10 per cent allowance for greater fuel consumption be made. But the latter is only a fraction more than twice as much as the former, though the destructiveness is three times as great. To make the total charge three times as much the registration license should be five times as great on a vehicle using solid tires if, on one of the same size equipped with pneumatic tires, the registration tax is about equal to the average gasoline tax.[2]

The conclusion then is fairly obvious that proper employment of the registration license involves (a) steeply graduated rates in proportion to the weight of the vehicle and load combined and (b) a rate five or more times as high on vehicles equipped with solid as on those of the same weight equipped with pneumatic tires.[3] It involves also taking account of the fact that destructiveness of the small vehicle using pneumatic tires when operated on high-grade pavements is almost nil. Consequently the only charge necessary in addition to the gas tax in a state with a preponderance of high grade pavement, which presumably means relatively small need for highway revenue, is a relatively small fee merely sufficient[4] to cover the cost of administration and road policing plus some remuneration for especially expensive "peak-load" use. This fact obviously makes it possible to secure the graduation suggested above without reaching unduly high rate levels.

The argument thus far has suggested, and it ought to be explicitly said, that there appears to be no justification for discrimination in the registration tax on account of the purpose for which a vehicle is used, but only on the bases of gross weight (of vehicle and capacity load) and tire equipment. If it is true that a property-carrying car is used more continuously than a passenger vehicle, it is also true that it uses more fuel and is consequently more heavily taxed under the gasoline tax. Even if that be slightly inadequate, it is better to ignore such unimportant distinctions because otherwise really important matters—weight and tire equipment—will be overlooked or administration unnecessarily complicated.

Level of Rates.—It is suggested that the revenues derived from the two forms of the tax, especially designed for metering the highway to the road users, should ultimately be adequate to pay the cost to the state of providing the automobile roads and streets in so far as they are not provided by imposts on those receiving indirect benefits. For example, it is often more convenient for cities and suburban communities to collect revenues by means of special assessments from indirect beneficiaries of the highways, that is, from nearby property owners, rather than that the money be raised by means of added taxation imposed directly on highway users. This ideal of meeting all the road cost (less that borne by others benefited) by special motor taxes can be attained at the present time only in certain states and should not be realized at the expense of too great a sacrifice by motorists. (But perhaps it is not possible in objective terms to define what constitutes "too great a sacrifice by motorists.") It should be said that, contrary to the view expressed by one recent writer,[5] the ideal is not now being reached by the country as a whole unless the entire question of city street cost, amounting in 1927 to more than half a billion dollars, be completely ignored. (It must be admitted, of course, that some small part of this total cost resulted from other causes than demands for motor transportation facilities.)

If the combination of taxes and level of rates suggested above be made effective, the problem of competition with other types of transportation agencies will not arise so far as special highway taxation is concerned, since in each case the different transportation agencies will provide their own facilities and since competition will tend toward the development of the agency best fitted to render each particular class of service.

General Taxation of Motor Vehicles.—The other type of motor taxation is general in character and should not be regarded as special motor vehicle taxation in any sense except sometimes as a matter of form. Two fundamental classes of such taxation should be distinguished.

In the first place, consistent with the principle implicity suggested above, if a property tax is levied on tangible personal property of other classes it should likewise be imposed on motor vehicles since ownership of such cars represents taxpaying ability in much the same sense as ownership of other classes of tangible personality.[6] Likewise it should be said that if an income tax is imposed on income from the employment of tangible personal property in general it should also apply to the income derived from the operation of motor vehicles.

Concerning the second type of general taxation, there is much less agreement and considerably more difficulty. The difficulty arises in large part from the fact that in legislation, and to a considerable extent in general discussions, the business taxes imposed on those who operate motor vehicles for profit have been regarded as special motor vehicle taxes. It seems more logical to think of them as business taxes very much like those imposed on railroads, interurban electric railways, street car systems and other transportation agencies. Generally speaking, in the imposition of such franchise taxes on motor transportation, whether in the form of gross receipts tax, passenger-mile tax, ton-mile tax, or otherwise, an effort should be made to make the rates such as to impose burdens as nearly as possible equivalent to the franchise taxes to which other transportation agencies are subjected, regardless of whether or not the forms of taxation are the same.

The form of franchise tax which meets most general approval from critics appears to be that based on gross receipts, though in legislation other methods have been more generously used. Perhaps the method which has been most often employed is simply a modification of the registration license to secure additional contributions from the operators of motor vehicles for hire. Other plans, slightly less crude, now used in a number of states, involve vehicle miles or ton or passenger miles which are scheduled to be run. The use of gross receipts as a basis for taxation, however, is increasing. Its superiority is generally regarded as resting on (a) the fact that it provides a measure of business done and (b) it is a method already employed in taxing franchises of other transportation agencies in a number of states.

There appears no good reason for any discrimination in this matter between the businesses operating as common carriers and those operating as

[1] Bulletin of the National Tax Association, April, 1927, Vol. XII, No. 7, p. 202.

[2] Ibid., p. 202.

[3] If the gasoline tax continues to increase in relative fiscal importance, the factor must tend to become greater than five.

[4] Since fuel taxes levied according to road use will pay the remainder of the total cost without unduly high rates.

[5] C. H. Sandage, "The Question of Motor Vehicle Subsidy," Bulletin, October, 1929.

[6] No attempt is made to develop the best method of collecting such a property tax, especially as to whether or not it should be collected as a part of the registration license.

contract carriers, unless the former enjoy special privileges conferred by the state and not shared by the latter. In certain cases such special privileges are undoubtedly available to the public utility but not to the contract carrier. They may include protection from unfair competition as well as certain highway privileges, such as right to park on the pavement, special reserved spaces, et cetera, which are not ordinarily available to contract carriers.

Summary.—Summarizing, then, it may be said that there is a tendency, which ought to meet approval, to impose special gas and registration taxes on motor operation sufficiently high to pay street and rural road costs that would not have been incurred in the absence of the motor vehicle and that are not more conveniently collected from indirect beneficiaries of the highways. This can be done immediately in most of the older states but must come more slowly in some immature states of the south and west. General taxes, as those on property or income, should apply to motor vehicles or the income derived from them to the same extent as to other tangible personal property. If other transportation businesses are subject to a franchise tax, motor transportation business, whether common carrier or not, should be taxed at rates which impose a substantially similar burden, though the method may properly be different.

Regional Planning as a Solution of Traffic Congestion

REGIONAL planning is shown to be the ultimate solution of traffic congestion in a comprehensive study of its causes, its costs, and its remedies made by the traffic committee of the American Road Builders' Association. Results of the study were made public on April 12 by Dan R. Lamson, committee engineer.

Among the principal causes shown are:

1. Highway registration (local vehicles).
2. Outside registration using highways in the area.
3. Lack of parking restrictions.
4. Narrow and poorly planned highway systems.
5. Lack of adequate entrances and exits to cities.
6. The larger cities geographically hemmed in by waterways.

Thirty miles from the heart of the central city of a regional area is the maximum distance of local influence. The New York area, even, could be included within these limits. This distance scales down some ten miles around the smaller cities.

It is in these areas that are found traffic conditions which set the maximum standards of right-of-way, surface width and pavement design. Here occur the most expensive construction projects, the highest costs of additional right-of-way, and the greatest obstacles to successful completion of a highway improvement program. This is especially true of the central sections of cities where insufficient right-of-way was set aside originally for highway purposes.

Obviously there is a certain amount of "through" long-distance traffic in any area which travels beyond the 30-mile zone, but these amounts are very small when compared with the local traffic operating within such a zone.

In the Cleveland area, only 1½ per cent of the passenger car traffic on the through trunk highways crosses the regional area between outside points. Over 95 per cent of the daily passenger car traffic entering or leaving the city does not travel beyond the regional area limits, 30 miles from the center of Cleveland.

The cost of traffic congestion is estimated at $81,000 per day in Boston, was $600,000 a day in Chicago prior to the inauguration of the regional improvement program, and is estimated at $1,000,000 a day in New York.

The loss of time because of traffic congestion in some instances in large cities is making transportation by horse-drawn trucks more economical than by motor driven vehicles.

Lack of highway facilities has retarded the purchase of automobiles, notably in New York, Chicago, Philadelphia and Boston. Per capita comparisons of registration figures were made with such cities as Detroit and Los Angeles which have an abundance of wide exits and high speed arteries. Using the Detroit ratio of 3.5 persons to the automobile, the four former cities should have a total increase in registration of 1,950,000 automobiles, but they do not.

Grade crossings at highways and railroads contribute an ever-increasing item to the cost of traffic congestion. A study of one of Cleveland's principal streets over a twelve-hour period shows that, of the 5,955 vehicles passing over a grade crossing intersection during that time, 1,867 or 31.4 per cent, were delayed there. In other words, the thoroughfare could be said to be only 69.6 per cent efficient.

Remedies advanced for reducing congestion are:

That a model regional planning organization be drawn up for use of smaller cities; that state legislatures authorize and control regional planning in congested areas; that equitable methods of financing, planning and construction be studied and recommended.

That in locating highways, state highway departments build trunk lines around cities; that a minimum right-of-way width be adopted, of 100 ft. for primary and secondary trunk lines, and of 66 ft. with a two-lane roadway, for rural roads.

That the authority for the location of grade crossings should be vested in the state highway commission or some state public utility commission.

That immediate financing and construction is favored of specific projects in regional areas as recommended by the commission in charge.

That state and county highways having an average daily present traffic in excess of 4,000 vehicles shall be designed with more than two traffic lanes of pavement; those with between 1,200 and 4,000 vehicles, not more than 10 per cent of which is truck traffic, to have two traffic lanes, generally paved; roads with less than 1,200 vehicles daily, not more than 10 per cent truck traffic, shall have two traffic lanes with some type of all weather surfacing.

385 Grade Crossings Eliminated from Federal-Aid Roads in 1929

In 1929, a total of 385 railroad grade crossings were eliminated on the Federal-aid highway system, according to a report just issued, April 8, by the Bureau of Public Roads of the U. S. Department of Agriculture.

Forty-eight crossings were eliminated by the construction of grade-separating bridges carrying the highway over or under the railroad; and 337 by relocation of the highway to avoid the railroad. Since 1917, the records of the bureau show, a total of 4,676 grade crossings have been weeded out of the system—995 by grade separations and 3,681 by relocations.

Georgia heads the list with 82 eliminations in 1929. Alabama is second with 40; Texas reported 34 eliminations; Montana 27; Mississippi 18; Kansas and Washington each reported 15; Arkansas, South Carolina and Wisconsin each 12; Florida, Nebraska, Oklahoma and Wyoming each 10; and Minnesota and Virginia each weeded out 9.

Texas heads the list of elimination by grade separations with 9; Kentucky is second with 6; Wisconsin reported 5; Montana, New York, Oklahoma and Oregon each reported 4; Connecticut, Missouri, South Carolina, Utah, Virginia, West Virginia and Wyoming each reported 5.

In the list of eliminations by relocation, Georgia leads with 94; Alabama is second with 43; Texas reported 25; Montana 23; Mississippi 17; Washington 14; Kansas 13; Arkansas 11; Florida 10, and Nebraska and South Carolina each 9.

Shoulder Hardening and Maintenance

Experience of Connecticut in Increasing Value of Shoulder for Traffic Use—Asphalt and Tars Applied to Gravel, Sand and Sand-Clay—Actual Maintenance Costs Reduced by Treatment

By GEORGE E. HAMLIN
Superintendent of Repairs, Connecticut State Highway Department

IN the road of colonial times there was no shoulder, the design being for single-way traffic with necessary natural or constructed turnouts for opposing traffic to pass.

This type of highway was limited to the lowest possible expenditure and followed the line of least resistance, winding along the ridges, avoiding ledges and other natural obstructions, from farm to farm and from settlement to settlement. The time of transportation was considered as of less value than the money required to reduce the highway length and increase the speed and load.

With increasing population delays due to road conditions became serious. Competition in commodity delivery began to manifest itself, to the detriment of the producer with the long haul and limited load. Community service was enlisted for the elimination of the swamp hole, the dangerous turn and the heavy grade. The increasing use of the road demanded more frequent turnouts until these became continuous and there emerged the two-way travel path furnishing a continuous line for traffic in both directions over the length of the highway.

As travel increased in speed and volume, there also grew the demand for wider travel paths to avoid the necessity, when passing other vehicles, of departing from the road surface to the undeveloped roadside, with loss of time and possibility of accident.

The maintenance cost of the travel path also increased unreasonably due to the presence of water on its edge with lack of facilities for drainage away to a low point. In an effort to meet these demands it became customary to clean the obstructions from the side of the road to a low point where water could be carried with the least inconvenience to the road user.

As in the case of the travel path, isolated cleaning soon became continuous cleaning and the shoulder emerged as an integral part of the highway. In turn this shoulder furnished satisfactory service until increase in speed demanded that more clearance be given a passing vehicle to insure safe operation and prevent the forcing of the outside wheels of each vehicle to an impermanent surface, uncompacted, with the possibility of accident through side slipping.

To increase the value of the shoulder for travel use on those roads where lack of funds prevents the construction of a new travel path of modern width, as well as to safeguard the new travel paths against moisture and breaking down of the edges, has been the attempt in Connecticut.

It is probable that the experience of Connecticut approaches nearly the experience of each other state in the east. The original travel path was constructed 14 ft. in width and seldom exceeded 16 ft. Even these original widths were reduced by increasing traffic to a point where lack of clearance continually caused the use of the impermanent shoulder. The consensus, under present conditions, seems to point to a minimum of a 10-ft. width for each planned traffic lane for safety and convenience. In the meantime many of the narrow roads must be maintained under increasing traffic, with safety demanding the widening of the present travel path to a condition reasonable for travel.

It is not practical to rebuild all roads to their ultimate width immediately. The available funds require a wholesale method of widening at the lowest cost to allow a balance for reconstruction purposes in the most congested regions.

With these conditions in mind the highway maintenance department of the state of Connecticut has been endeavoring, by treatment of shoulders, to give the additional width required for travel and reduce the need for continual maintenance caused by weather conditions, keeping the cost at the lowest possible figure.

When first considering the bituminous treatment of shoulders it was generally agreed that this treatment would be of value only during dry periods, and that any such treatment would tend to break up under frost and water conditions in the winter and spring. The plan, therefore, was tried out to a limited extent to develop the possible value under conditions of both good and poor shoulder materials. We have found out that our original supposition is not correct, but that, under varying soil condition, results can be obtained wholly justified as to cost, value and length of life.

In this shoulder treatment both asphalt and tars have been used, and from the results obtained our general practice has been established. Shoulders are first graded to establish, as far as possible, a uniform cross-slope, this conforming to the cross-slope of the travel path, and being an extension thereto. A first application is made of 45 per cent asphalt road oil in the amount up to ½ gal. per square yard, or as much as the shoulder material will absorb. A hone is used to incorporate the bitumen into the shoulder material so as to form a uniform mixture. This mixture is then allowed to set, honing being continued as the material goes into place under traffic so that eventually a reasonably smooth, uniform cross-slope grade is obtained.

New London Turnpike: Shoulder Treated with 45 Per Cent Asphalt Oil, with Top Treatment of 65 Per Cent Asphalt Oil

Putnam-Mechanicsville Road, Showing Former Location of Trolley Track, Now Removed, Filled with Gravel, Tar-Treated and Honed. Stone on Road Shows Former Location of Inside Rail

If the material is particularly sandy the first application of bitumen may be followed by a second or third in the amount of about ¼ gal. per square yard, until a uniform mixture of asphalt and shoulder material to a depth of approximately 2½ to 3 in. is obtained. The final treatment, in general, consists of an application of from ⅛ to ¼ gal. of cold surface tar which is covered with sand and honed as a part of the travel path. Results are necessarily commensurate with the classes of material used.

Gravel can be successfully compacted in this manner. Sand even of considerable depth can be stabilized. A certain admixture of clay will yield to the treatment. We have no knowledge of whether clay can be treated when not in combination with other materials, this condition not having been encountered. I would, however, believe from our experience that a clay shoulder to which sand has been added may be treated successfully with bituminous materials.

The safest method to judge results is by costs, providing that service is given. We have found that the actual maintenance cost after the shoulders have been treated is reduced below the maintenance cost of the untreated shoulder. The total maintenance cost in the state of Connecticut, with travel doubling in about six years, has varied little during that period. There has been a distinct reduction in the cost of maintenance of the travel path, as the breaking down of the road edges due to impermanent shoulders has largely ceased, and the greater part of water conditions under the travel path due to entrance from the shoulders has been eliminated.

Brooklyn-Canterbury Road: Gravel Surface, Placed Loose and Honed Into Shape; Four Applications of Tar, Followed by Honing; No Roller

Gravel Road, 12 Ft. Wide, Which Has Been Widened with Additional Gravel, Honed Into Place to 24-Ft. Width. First Application Is 45 Per Cent Asphalt Oil; Surface Is Tar-Treated

One particularly notable result has been the usability of the shoulders during the spring period where, before treatment, soft conditions would frequently cause the miring of a car leaving the travel path. While these shoulders at a few locations may break under abnormal conditions, in general they furnish a fairly satisfactory riding surface even in the early spring. This is particularly true where treatment has been given in the previous late fall and the bituminous material remains alive throughout the winter.

By shoulder treatment we believe that a wider travel path has been furnished, that the constant maintenance of the shoulders due to storm washing has been largely eliminated and that a narrow road has been increased to a reasonable width for modern two-way travel at a low cost.

Acknowledgment.—The foregoing is a paper presented at the annual meeting of Highway Officials of the North Atlantic States.

Control of Highway Loading

Early History and Present Methods of Controlling the Overloading of Motor Vehicles

By J. T. SHARPENSTEEN

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BEFORE the time of improved highways, movement of heavy commodities was confined almost exclusively to rail and water transportation. With the advent of improved roads, horse-drawn vehicles were enabled to carry heavier loads, but the size of such loads was not sufficient to cause any alarm or to warrant the adoption of restrictive measures to prevent the destruction of such roads.

In the early days of road building the anticipated life of gravel and macadam surfaces was much greater than the facts now justify. A much longer life would have been realized, however, had not the motor-driven vehicle entered the field of highway transportation. The load-carrying capacity of the early motor vehicle was small but progress in the automotive field produced, in a comparatively short time, motor vehicles, with maximum load capacities, that could not be operated on the highways under all conditions without destructive results to the road surfaces. Attention was first forcibly called to this condition during the World War when heavy truck hauling of war materials between industrial centers resulted in serious damage to the roads. This demonstration of the effect of heavy loading on the then existing types of surfaces showed plainly, the condition would have to be met by heavier and more substantial designs or by legal restrictions. Efforts to accomplish the desired results have been made along both lines.

The First Attempt.—The first attempt to control highway loading in Michigan by legal means was made by the legislature of 1917. A law was enacted at that time providing as follows:

It shall be unlawful to operate any vehicle upon the public highways of this state, the gross weight of which exceeds fifteen tons.

It shall be unlawful to operate any vehicle, except motor-driven vehicles, upon the highways of this state, the gross weight on any wheel of which exceeds that given in the following schedule:

Size of tire in inches	Single tire: Maximum wheel load in pounds	Single tire: Miles per hour	Double tire: Maximum wheel load in pounds	Double tire: Miles per mile
2	700	20	1,400	18
2½	900	20	1,800	18
3	1,200	20	2,400	18
3½	1,600	20	3,200	16
4	1,900	18	3,800	14
5	2,200	16	4,400	13
6	2,700	14	5,400	12
7	3,200	12	6,400	10

The figures in the above table are for a wheel 32 in. in diameter. For larger wheels the maximum load is increased 10 per cent over that of a 32-in. wheel for each additional two inches in diameter.

Whenever by the thawing of frost, or rains, the roads are in soft condition, the maximum carrying capacity of tires on all vehicles shall be limited to one-half of the carrying capacity of tires as provided for in the act.

The maximum penalty for the violation of this law was a $50 fine and a 30-day jail sentence. The enforcement of the act was placed in the hands of the sheriff of each county and it was his duty to appoint as his deputies all county, district and township highway commissioners, and others where necessary.

This act was amended in 1919 by providing that no truck shall haul more than two trailers.

The Law of 1923.—The legislature of 1923 repealed the acts of 1917 and 1919 and substituted a law providing for a maximum gross load of 600 lb. per inch of width of tire on any wheel, of any vehicle, except motor-driven vehicles. For motor-driven vehicles the maximum gross vehicle load was placed at 14 tons but in no case could the wheel load exceed 700 lb. per inch of width of tire. Limitations were also placed on axle loads, providing for a maximum gross axle load of 18,000 lb. If the spacing between axles was 10 ft. or less, the maximum axle loading was reduced to 13,000 lb.

Provision was made for protecting the roads whenever by reason of the thawing of frost, or rains, or due to new construction the roads were in a soft condition. The state highway commissioner was empowered to limit to one-half the gross axle load or to one-half of the carrying capacity, as determined by tire regulations and as provided for in this act.

Width of tire in inches	1	1½	2	2½	3	3½	4	4½	5
Maximum wheel load in pounds	400	600	800	1,100	1,400	1,800	2 200	2,700	3,200
Maximum load for 4 wheels	1,600	2,400	3,200	4,400	5,600	7,200	8,800	10,800	12,800

The schedule for wheel loads on motor trucks and trailers with allowable speeds was as follows:

The penalty for violation of this act provided for a fine not to exceed $100 and costs of prosecution. The enforcement of the law was made the duty of the sheriff of each county or of any peace officer of the county.

The Amendment of 1927.—The legislature of 1927 amended this act to provide for the determination of maximum axle loads on all roads between June 1 and March 1 according to the following table:

Spacing between axles	Maximum axle load, lbs.
9 ft. and over	18,000
8 ft. 6 in. to 9 ft. 0 in.	16,500
7 ft. 6 in. to 8 ft. 6 in.	15,000
6 ft. 6 in. to 7 ft. 6 in.	13,000
5 ft. 6 in. to 6 ft. 6 in.	11,500
4 ft. 6 in. to 5 ft. 6 in.	10,000
3 ft. 6 in. to 4 ft. 6 in.	8,500

These axle loads are permissible only when the load on any wheel does not exceed 700 lb. per inch of width of tire.

For the months of March, April and May reduced loading is provided for and is based not only on the axle spacing and the size of tires but on the type of road over which the load is transported. The following table shows the maximum gross axle load allowed on the different types of roads:

Spacing between axles	Maximum axle loads: On concrete pavements on pavements with a concrete base lbs.	Maximum axle loads: On all other roads, lbs.
9 ft. and over	13,500	10,000
8 ft. 6 in. to 9 ft. 0 in.	12,400	9,200
7 ft. 6 in. to 8 ft. 6 in.	11,200	8,300
6 ft. 6 in. to 7 ft. 6 in.	9,700	7,200
5 ft. 6 in. to 6 ft. 6 in.	8,600	6,400
4 ft. 6 in. to 5 ft. 6 in.	7,400	5,500
3 ft. 6 in. to 4 ft. 6 in.	6,300	4,700

On concrete pavement or pavements with a concrete base the maximum load on any one wheel shall not exceed 525 lb. per inch of width of tire, if axle spacing is 9 ft. or over and shall not exceed 450 lb., if axle spacing is less than 9 ft. In the case of all other roads the wheel load shall not exceed 450 lb. per inch of width of tire for any axle spacing.

The state highway commissioner may suspend the restrictions imposed by the foregoing act during the months of March, April and May, when and where, in his discretion, conditions of the highways warrant it. By an act of the legislature of 1929 further authority was given the highway commissioner to limit traffic at any time in the interest of safety. This law is especially applicable to inadequate bridges. When the provisions of this act are complied with the maximum load permissible on any such bridge may be restricted to any size consistent with

safety as determined by the state highway commissioner.

Enforcement of the Law.—Laws are of little or no value unless enforced, and it may be assumed that any law will be violated. The enforcement of the vehicle loading law has not always been given serious consideration in all parts of the state at all times of the year. During the spring, when the stability of subgrades is impaired, there has been considerable activity in apprehending violators, but during the balance of the year comparatively little attention has been given the matter. With an ever increasing amount of truck traffic and a keener realization of the destructive effects of heavy loads, the necessity of a more rigid and uniform enforcement of the vehicle loading law at all times of the year is apparent.

During the past year it became evident that a change of policy in enforcement was desirable. The elimination of any of the agencies that had previously handled the matter was not contemplated, but it was believed an effort should be made to provide means for supplementing their activities. According, the state highway commissioner caused to be placed in the field full-time truck weighing crews adequately equipped to weigh trucks suspected of being overloaded.

One of these crews, consisting of a state highway department employee and a state police officer, was assigned to each of the following residencies: Jackson, Kalamazoo, Grand Rapids, Saginaw and Port Huron. Three crews were assigned to the Plymouth residency. These eight crews are under the immediate direction of the resident maintenance engineer, who prepares or approves a schedule of operation and otherwise directs the activity of the crew. Each crew is equipped with a pair of portable hydraulic scales or loadometers as they are called. Weighing is conducted at such times and places as the movement of truck traffic seems to warrant.

Tipping Off Weighing Operations.—In some districts frequent changes of location have been found necessary on account of truck drivers being informed that the crew is checking at a certain point, enabling loaded trucks to detour. Information as to the presence of a weighing crew at any point is obtained by truck operators in various ways. A popular means of transmitting this information is for a truck driver, on observing weighing operation, to flash his headlights twice on meeting another truck. Where optional routes are available, the heavily loaded truck will change its route. The telephone is used to warn truck operators and several instances are known where scout cars were sent out to ascertain the whereabouts of the weighing crew.

These crews started work about the middle of last July. Any truck that is apparently carrying a heavy load is stopped and if, after a closer inspection of the load is made, the weighmaster is not satisfied that the truck is within legal limits, the load on each wheel and on each axle is ascertained before the truck is allowed to proceed. In case any wheel or axle is found overloaded the truck is detained until the load has been reduced to the legal limit by transfer of part of the load to another truck or by other means. The truck driver is either taken into custody by the police officer or given a summons to appear before a certain justice of the peace at a certain time for arraignment. A complete record of each truck weighed is forwarded to the Lansing office of the highway department.

Data on Weighing Operations.—A summary of the data secured from all trucks weighed between July 15 and Dec. 31, last year, affords some interesting statistics. The number of cases involved and the length of time which the record covers may not be sufficient in ever instance to afford a basis for definite conclusions, however, the information is given for what it is worth.

During this period a total of 4,309 vehicles were weighed. These vehicles were classified as follows: Single trucks 56 per cent; 6-wheel trucks, 20 per cent; trucks with one 4-wheel trailer, 13 per cent; trucks with two 4-wheel trailers, 5 per cent; 6-wheel trucks with one 4-wheel trailer, 6 per cent. The loads on 12,207 axles and 24,414 wheels were determined.

The fact that only one vehicle in every five that was checked showed an overload on one or more axles or wheels, indicates that few, if any, overloaded vehicles were allowed to pass without being weighed. By excluding data for the Saginaw district it was found that 4.1 per cent of all axles and 4.7 per cent of all wheels were overloaded, which in other words means that a little more than twice as many wheels as axles were overloaded. This proportion is uniformly true for all the districts except Saginaw where 2.2 per cent of the total number of axles and 7.8 per cent of the total number of wheels were overloaded, from which it can be seen that seven times as many wheels as axles were overloaded. Just why the proportion between overloaded axles and wheels in the Saginaw territory should vary to such an extent from the proportion in other districts offers an interesting question for investigation.

While 925 vehicles were found overloaded and as many arrests could have been made, only 430 offenders were taken into court. In about 92 per cent of the cases convictions were secured, and the fines and costs combined averaged $22.50 for each conviction. In those cases where overloads were found and no arrests were made, the amount of the overload was very small and was reduced to the legal limit by shifting the load in the vehicle.

In the Jackson residency, the weighmaster made a record of the total number of trucks passing every weighing station during the time checking was in progress. From this information and the record of vehicles weighed the percentage of the total number of trucks which were overloaded was determined. The data secured at different points on a given road were combined and the following results obtained: U. S. 16, 1.37 per cent; U. S. 12, 2.39 per cent; U. S. 112, 1.06 per cent; U. S. 127, 1.37 per cent; or an average of 1.61 per cent for the four roads combined. Using this figure, which is only an approximate average for the section under consideration, and the average daily total traffic as determined by the traffic census, the approximate number and percentage of overloaded vehicles, passing a given point in a given time can be determined. The estimate for a few well known locations is given as follows:

Location	Average daily total traffic	Total trucks	Overloaded trucks	Per cent of overloaded vehicles
Between Flint and Saginaw	4,587	313	5	0.11
Between Detroit and Pontiac	37,816	3,695	59	0.16
Between Howell and Lansing	5,285	486	8	0.15
Between Jackson and Battle Creek	2,913	228	4	0.14
Between Benton Harbor and New Buffalo	2,272	223	4	0.17
Between Ypsilanti and Detroit	3,684	251	4	0.11
Between Coldwater and Sturgis	1,715	122	2	0.12

The average per cent of overloaded vehicles for the seven locations is 0.15 per cent. For all parts of the state outside of industrial areas the percentage of overloaded vehicles is probably less than this figure.

One very definite conclusion can be drawn, namely, that there are vehicles on the highways carrying loads of a greater weight than the maximum weight allowed by law. There is not sufficient evidence to say that increased activity in enforcing the law has had any marked effect in reducing the number of cases of overloading. The average penalty assessed is too small to expect that that alone will reduce the number of violations. No doubt, in many cases, fines can be paid from the increased revenue received from transporting that part of the load that is in excess of the maximum legal load. Cases are on record, where overloads of more than 16,000 lb. on one axle have been found and cases of 5,000 or 6,000 lb. overload are not infrequent. The fact that an illegal load may escape detection is conducive to the continuance of overloading.

Acknowledgment.—The foregoing is a paper presented Feb. 12 at the 16th annual Highway Engineering Conference at the University of Michigan.

The Maintenance of "Washboard" Macadam Roads

Present-Day Traffic Demands Smooth Surfaces—Importance of Drainage—Corrugations Removed by Bituminous Applications and Dragging—Methods, Equipment and Precautions

By N. W. HARDENBERGH

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THE subject "Maintenance of 'Washboard' Macadam Roads" would seem to bring to the mind of every engineer and maintenance man of our highway departments all the trials and troubles that can befall any and all of the various departments that comprise our state highway commissions, for all the heads of the different departments in these state highway systems are at fault and to be blamed, in one way or another, for what we term "washboard" roads. The engineer may be at fault in locating or relocating the road and neglecting to give proper study and consideration to the nature of the soil, and especially the subsoil, through which the road is built, or for failure to provide suitable and adequate drainage. Especially has improper drainage been the foremost cause of washboarding. Likewise does the maintenance man fail, by not maintaining suitable drainage or at least carefully maintaining and saving such drainage as may have been provided by the construction engineer; and when the matter of drainage is lost sight of by both the engineer and the maintenance man, all effort and labor for better surfaces are lost, no matter how diligently these labors and efforts may be pursued. The road must, by nature, disintegrate when saturated with water, and nothing can result but a broken washboard surface.

Causes of Washboarding.—Let us take into consideration all the causes for washboard roads that have to be considered in the maintenance and care of macadam roads today. I think we are generally agreed that drainage is the chief cause for many of the uneven and broken surfaces, especially on our older types of macadam roads; but there are other causes of equal importance, such as the kind and quality of material used in the construction of the road, the manner in which the material was placed and the proper finishing and rolling of the surface. These are the primary causes, but the construction of the shoulders, gutters and watercourses has a great bearing on our ability to keep and maintain the surface in an unbroken and smooth condition.

In the maintenance of washboard roads it becomes necessary to study carefully all the causes as outlined above, and to attempt, so far as practicable, without rebuilding, to correct such wrong and injurious conditions before attempting to improve or eliminate the rough and uneven surface. Lack of drainage being the major cause for a washboard surface, it becomes necessary not only to provide ways and means to keep the water from seeping through or under the surface of the roadway, but also to provide ways to remove such moisture and water as may accumulate by condensation and the suction from traffic passing over the surface. This can be accomplished by providing deeper and better waterways and by keeping the water level as low and as far away from the traveled path as possible. We must also give attention to the drainage of the sub-base, especially where the soil may be heavy and have a tendency to hold the water. Many ways of caring for this water may be resorted to, such as rubble drains, cross drains or tiling. If the most careful attention is not given to this drainage and means are not provided to care for all the water that may find its way under the traveled section, it will be but a waste of time and money to attempt to maintain a surface that will meet the demands of present-day traffic. By locating our gutters and ditches as far from the traveled section as possible, we create safer driving conditions for the public, for we are enabled to build shoulders with less slope and we can also eliminate, in many places, the guard rail, which has become a great menace. We find that the lowering of our gutters and waterways relieves, to a great extent, that seepage through the surface caused by the pressure of the water under the bituminous top. By relieving this seepage, much labor is saved in repairs, such as patching, sanding soft tops and the dragging or smoothing of the surface where all the bitumen has been loosened from water pressure and has become rough and bumpy.

Original Construction at Fault.—In the matter of materials used and the manner of construction of our macadam roads it would seem that this cause for washboard roads might be placed on about the same level as drainage. So far as the maintenance man is concerned, it doubtless should be placed first of all the troubles, for how is the maintenance man to overcome careless and wrongly constructed surfaces, when no amount of careful maintenance can ever counteract the work of an incompetent roller man or a shiftless inspector? This wrongful construction must be rectified and to do so requires many and different operations, such as scarifying and rolling the very bad sections where corrugations have been rolled in and further compacting the surface which has been left in a very soft condition. In many instances it is necessary to dig out the old and establish a new base course, but these methods of overcoming the errors in construction are costly and too much time is consumed to make them practicable. Therefore the maintenance man must resort to patching the broken and uneven surfaces or must overcome the corrugations by building up a pad or mat of bituminous material. This manner of rectifying construction mistakes is but a makeshift and should not become a general practice as it only invites further trouble with washboard roads. Of course, we recognize the fact that the modern methods of construction and the more careful inspection given in the construction of our present-day macadam roads, have relieved, to a great extent, the work of the maintenance man in keeping the travel portion smooth and free from corrugations. Yet it still behooves the construction engineer to see to it that the travel section shall be so firmly bound and so well filled that there will be no action of slipping of the surface under traffic. Had this attention been given to proper rolling and binding in years past, we of the maintenance divisions would not be getting the blame so generously handed us by the modern, fast-driving motorist.

Maintenance of Shoulders.—During the past four or five years, we have come to realize that the construction of the shoulders of a road is a very important factor in maintaining a smooth riding surface, and especially is this true of the macadam type of road. In years past it seems to have been the practice to build the shoulders of any material that could be obtained handily and at little cost. Many times this material has been muck, loam or sand and even boulders and stumps have been used. In fact, the shoulders seem to have been the dumping ground for

all the rubbish on the job. By using such material for shoulder work there was created a condition that invited trouble from water, frost and broken edges; especially in poorly drained or swampy locations did this slip-shod shoulder construction cause the trouble we are trying to remedy today. Instead of the shoulder holding away and shedding the water, thus keeping it from under the travel path, it has acted as a sponge to hold the water and has turned the base course into a rubble drain, which, with the washing away of the binder, softening of the sub-base and creation of excessive frost action, has caused the top to loosen and roll, weakened the whole substructure and created a condition that cannot be corrected or repaired without reconstruction of the whole section and the expenditure of money which would have paid far greater dividends had it been used in the construction of shoulders with materials suitable for the purpose. We have found, in Connecticut, that our surface conditions are greatly improved by cleaning the shoulders of all vegetable growth, such as grass and weeds, and by not allowing any sod to accumulate against the metal or surface section. By the removal of all growths and rubbish we are enabled to keep the shoulders in a smooth condition and tight up to the traveled portion of the road so that no water can accumulate on the shoulders and saturate the traveled section by suction or drainage, which, as I have pointed out, does happen where the sod acts as a sponge or where the shoulders are rutty or broken. During the past four years we have been maintaining our shoulders at least 4 ft. in width, keeping them free from all growths and applying treatments of both asphalt and tar, and we certainly have been more than repaid for this work, by the reduction in the costs of surface treatments and maintenance costs on the traveled portion of our roads. Furthermore, we have, in a great many locations, added to the driving width of our roads from 4 to 8 ft., thus relieving the center section from excessive wear and the consequent demand for more frequent care of the surface.

Preparing for Application of Bitumen.—These conditions, in the main, seem to be the primary causes of washboarding, but there is yet one other source of trouble to be considered, and it should be given very careful consideration. That is the preparation of the surfaces of macadam roads for the first application of bitumen. In most cases we find that the first applications of bitumen were made, in years past, without proper preparation of the surface before the bitumen was applied. It never occurred to us that the surface of a newly constructed macadam road should be properly cleaned and broomed to such an extent that no dust or other accumulation of binder or dirt is left on the surface to form a mat or pad under the bitumen and thus stop or retard the penetration and bond to the metal of the road, so vital in keeping the bitumen from pushing and in the prevention of rolling under the throwing and grinding action of traffic. In Connecticut, we have been very careful to see that all newly constructed roads are filled or covered with bitumen, are thoroughly scoured and cleaned, so that the voids in the surface are free from all loose and foreign matter, and that a perfect bond with the bitumen is made. We have learned to our satisfaction that this careful preparation has effected a big saving in the maintenance costs on all roads so carefully prepared. During the past five years all such surfaces so thoroughly prepared have caused us no trouble and there has been no slipping or bunching of the bitumen nor any tendency toward washboard surfaces.

New Methods Required.—In Connecticut, as in all states, we are concerned with many—perhaps all—of the types of roads known to road builders, from the modern four-lane concrete to the graded dirt roads, and they all come under the care and maintenance of the highway department. The great drawback to this situation is the fact that all roads are just roads to the traveling public and it cannot know, nor does it care, what technical kind or type of road it is traveling over. It does know, however, and all too well, when these roads are rough, and it has become most insistent that all surfaces shall ride alike and be smooth at a fast or slow pace. Therefore, it has become necessary to find ways and means to maintain the older type of roads in such condition they will ride as smoothly and comfortably as the modern concrete surfaces. The effort to accomplish this has brought about a more modern and better manner of treating and maintaining the older macadam roads, especially those roads whose surfaces have become rough and corrugated by lack of proper maintenance or were left in a rough condition when constructed. Up to five years ago, we in Connecticut pursued the old methods of patching, oiling and dragging the surfaces with light planes or hones when it became absolutely necessary to do this under penalty of losing the whole surface, and we congratulated ourselves that we were doing all that could be done and that our efforts were well directed and economical.

With the coming, however, of the fast automobile and heavy trucks, it became very apparent that we were not keeping pace with the demands of traffic. We were compelled out of the necessity of saving our roads to adopt more modern, faster and better methods of maintaining and caring for the bituminous treated surfaces, especially on the older types of roads, which were continually acquiring washboard surfaces under modern traffic. Without knowing what the outcome would be and in some cases with success, we attempted many unheard of and seemingly impossible treatments, such as dragging with heavy planes, loaded with one or two tons of weight, in an attempt to cut down the bumps and remove at least a part of the thick mat of bitumen on the surface, that could not help rolling and becoming bumpy. At times, we were compelled to strip or remove all the mat of bitumen from the surface, especially where this bitumen was of poor quality, or had been badly applied, or where the bitumen had been filled with material which had seemed to rot and disintegrate the oil or tar, causing the binding properties to be lost. In those days we were doubly afflicted with roads, the surface of which had been covered each year with one or two gallons of oil or tar to the square yard and filled with all the sand or other material which could be absorbed by the bitumen and which had then been left to oxidize or cure. This we believed to be the purpose of oiling, to build a new surface; a theory which we later found to be false. After much experimenting and some mistakes, we have overcome many of the objections to the newer methods of maintenance and today our maintenance program is as different, compared with that of five years ago, as the methods of constructions used today compare with those employed in our first construction work.

With the ever increasing mileage being taken into our highway systems, the maintenance of road surfaces would seem to have reached a point where it is of as great importance as the construction of roads themselves. In fact it would seem that this view of the situation is now being taken by many of the highway departments, for one of our foremost highway engineers, remarked, not so long ago, that his advice to young men about to enter the highway engineering field, would be to take a course in highway maintenance engineering. As the maintenance divisions of our highway systems seem, however, to be limited as to finances and moneys available for the work, it is most imperative that the older methods and implements of maintenance be relegated to the scrap heap and less costly and more efficient methods employed, this doubtless being the real reason for the change in our methods in Connecticut.

Today, for example, the heating kettle is a piece of equipment very seldom used by our repair or maintenance crews, for the breaks are few and the need for patching is almost unknown. This withdrawal of the kettle from our maintenance work has been brought about by the fact that we have found that a smooth surface seldom breaks. We have adopted a plan of making a constant and careful inspection of the surfaces on all bituminous treated roads and when we find they are be-

coming brittle, weather-cracked or worn, we immediately call out the oiling crews and make an application of bitumen over the entire weakened surface, of such kind and in such quantity as seems to meet the needs of the surface requiring attention. This is done rather than patching or covering the small broken area from the heating kettle. This method we have found to be less expensive and more lasting. Furthermore it greatly enhances and speeds our work of keeping a smooth surface and is another factor in overcoming that washboard condition.

Honing.—On the older Connecticut roads where suitable care had not been given to the surface before the bitumen was applied, the maintenance was not what it should have been and the surface had become broken and bumpy, we had to resort to methods that were economical but thorough, methods that would smooth out the bumps and corrugations which were already formed and had become permanent. To accomplish this we resorted to that implement known as the heavy hone or drag. This heavy hone has become the most valued implement in use by the Connecticut Highway Department, for by its use we have been able so to recondition the surfaces of our older types of roads that they compare favorably with the later-constructed macadam surfaces and the traveling public is generally unable to determine as to the construction and kind of road over which it is riding. We use these heavy hones not only on the macadam type but on gravel, dirt or any road that can be covered with tar or asphalt. Where the hone is used all roads look alike and one section will ride as smoothly as another when finished. In fact, whatever improvement Connecticut has made in the maintenance of macadam roads can be credited in a great measure to the continual use of the drag or hone.

Application of Bitumen.—In further consideration of washboard macadam roads we must give very careful consideration to the application and filling of the oil or tar, as the case may be, and the manner of caring for this material after it has been spread on the road, as the manner in which this material is used and manipulated seems to afford the best, if not the only economical relief, other than resurfacing, that we have from corrugated and rough surfaces. As I have stated before, it has become the practice to use the distributor or oil wagon whenever and wherever needed, rather than use the heating kettle in our repair work. Experience has taught us that it is far better and more economical to make two very light applications regularly, one as early in the spring as practicable and as the weather conditions will permit, and the second as late in the fall as will allow the work to be properly done and well cared for. With the spring application due care and study must be given to the type of road to be treated and the condition of the surface after the strain of frost action, winter abuse and deterioration. After determining the treatment best suited to revive and smooth over the fractured surface, we apply from 1/10 to ⅛ gal. of either asphalt or tar to the square yard, filling this bitumen with screened sand, using only such an amount as will keep traffic from slipping and will also keep any of the bitumen from seeping off the surface.

As soon as possible after the application has been made, or when not more than a half-mile has been covered, we start the drags or hones, dragging the green or fresh bitumen. It may be desirable at times to give the hot bitumen a chance to penetrate the old surface or mat, especially where the surface has become corrugated or washboardy, but our experience has shown us that it is more dangerous to wait too long after the application, than to start the drags as soon as the application is made. Should the surface be broken and rough it is necessary at times to put one or two tons of weight on each drag in order to obtain the cutting effect necessary to shave off the bumps and corrugations. One will be agreeably surprised to see how quickly the old surface will become softened with the application of hot bitumen and how easily the heavy drags will shear off the bumpy spots and uneven surfaces and how cheaply this work can be done by a trained crew. The drags, working in pairs preferably, start on the outer edges and work the material to the center of the traveled section and then to the outer edge and again back to the center, repeating this operation as many times as are needed to shave off the bumps and corrugations. When the mulch, which has been worked up by this operation, begins to stiffen, an inspection is made of the surface to ascertain whether all the bumps and corrugations have been cut off. Should the surface be found smooth and free from bumps, the weight is taken from the drags and they continue moving the mulch over the surface to fill all depressions which cannot be cut out by the weighted drags. We have yet to find material which is any better suited for filling the depressions than this mulch, which is worked up on the surface of the road by the drags.

After the surface has been gone over by the drags without weight, all loose and excessive material is pushed off the surface by the drags on to the shoulders and in many cases it is left and smoothed down, thus building up a smooth waterproof shoulder surface and in most cases extending the riding area from 4 to 8 ft. After the surface has been cleaned by the drags of all loose material and the work with the drags finished, the entire surface is given a light dusting of fine sand, just enough to keep the bitumen from picking under traffic and to allow the material to cure and remain in as plastic a state as possible, for we have found that excessive sanding destroys the life of the bitumen. If this occurs we lose the waterproof film so essential for combating weather conditions and for retaining that resiliency of surface that is necessary if smooth roads are to be maintained. After the spring application of bitumen has been made and the surface smoothed out and refinished with the heavy drags, we continue with the dragging during the heated season of summer or whenever the roads show a tendency to become rough. This continued dragging enables us to remove any bumps or corrugations that may have been formed through slipping of the top or from excessive bitumen which was not removed at the time the application was made. It also enables us to move this excessive bitumen into any low places that may have been formed under the weight of traffic or into breaks on the surface which may have resulted from frost action or from extraordinary abuse. Such breaks become fewer each year with the proper use of the heavy drags.

We have come to believe in Connecticut that a light application of bitumen is especially important in the fall or just before cold weather sets in. We find that, by this, the life of the surface is removed, cracks and breaks are filled in and the whole surface is waterproofed, so that severe weather conditions and abuse from winter do not seem to mutilate the surface as badly as when only one application is made in the spring or early summer. We use the heavy drags on the fall applications in much the same manner as when the spring oiling is done, the only difference being that we do not give so much time to the cutting of corrugations and bumps, as we assume that these have been taken care of during the spring and summer. Therefore, it is only necessary to seal up the surface and remove the surplus material not absorbed or needed on the surface. The value of this fall oiling cannot be overemphasized. There is no work done or money expended by our maintenance divisions that will pay greater dividends or give such splendid results as this application of bitumen before the winter weather sets in.

Bituminous Material.—It is most important and essential, in undertaking this work of smoothing washboard roads with heavy drags, that proper bituminous material, whether asphalt or tar, be used; for it should be the purpose to use only such material as will soften the hardened surface, make it more or less pliable and enable the drags to mulch as much of the old material as possible. In Connecticut we use most generally for this work the tars of about the same consistency as the ordinary cold-tar applications, but in some cases it is necessary to use asphaltic oil, in which event we use

either 45 or 65 per cent. This seems to give the best results and cuts the old surfaces in just about the right way to enable the drags to shave off the bumps and still not produce a slippery mass that cannot be handled. With a little study the man in charge of the bituminous application will come to know just the proper treatment and the kind of bitumen necessary to enable the drags to mulch up the old surfaces and, in reality, form a new surface on the old base. On many of the older macadam roads in Connecticut, we have been inviting trouble, such as bumps and washboard surfaces, by the too-heavy application of bituminous material and sand, laboring under the delusion that the material was being spread on the surface to build up and maintain a top that would take the wear of traffic; but we have now come to realize that this was a grave mistake and in many cases the cause of the failure of our roads. We have learned through bitter and costly experience that our purpose should be to apply the oils and tars in as small quantities as possible —just enough to renew the life of the old surface, to fill the breaks and weather cracks and to waterproof the whole surface—and then remove the surplus material and let the metal of the traveled portion carry the weight of traffic, rather than build up a plastic mat that cannot help but push and become bumpy when exposed to and softened by the summer sun. It has become our practice to remove by dragging, each year, as much of this old mat of bituminous material as possible from our surfaces. Many of the older roads, which were formerly rough, but which have since been thus cut down to the metal, have become smooth, giving us very little or no trouble from breaks. Weather conditions have practically no effect on their surfaces.

Quality of Filler Important.—In Connecticut, we have always used sand as a filler or blotter for the bitumen when applied to the surface, and we have learned that this question of sand or filler requires as much care and study as the kind and quality of the oil or tar to be used. This is due to the fact that sand which carries a small percentage of loam, clay or slate will cause untold injury to the asphalt or tar, and create more bumpy and washboard roads than can be overcome or smoothed out by the maintenance crews during several months of hard labor. While dirty sand or filler may mean the failure of our oil application it must not be forgotten that sand or filler which shows a small percentage or even a trace of mineral deposits, such as iron pyrites, lead, mica or the like, will cause even greater harm than dirty sand, as this mineral formation, through slaking, will burn the bitumen. As a result, the surface will deteriorate and scale and the whole bituminous application will be lost. It is possible that two or three years may be required to overcome the effects of this mineral matter; in fact, all the particles may not burn out until the second or third application of bitumen has been made. Even then, the mat will not be satisfactory or substantial, but will show soft and hard spots, creating a bumpy surface that seems to resist all efforts to mulch. We found, as I have stated, from past experiences, that the quality of the sand or filler used in our oil applications has a great bearing on our ability to keep our macadam surfaces smooth. In order to obtain material suited for this work, we have at times hauled sand from twelve to fifteen miles, rather than use a sand of an inferior grade which might have been found within a mile of the location where it was to be used. However, this long hauling more than pays us in the quality of the surface we can produce on our roads.

While careful attention must always be given to the quality of the sand or filler, we must not overlook the further fact that the manner of application of this material on the bitumen is also of very great importance, for unless the filler is very carefully and evenly spread there will be created dry and lean places and fat or sloppy places that cannot give the smooth and uniform surface needed to satisfy the fast motorist. Even when the entire surface is mulched by the drags we may still have spots which are too dry and others so wet and sticky that it would be impossible to build up a plastic mat that will stand up under traffic and be lively during the period between applications of bitumen. The spreading of cover is done by hand, on our roads in Connecticut, and we endeavor to maintain crews of trained men for this work, as the inexperienced man will use more cover than is necessary and create bumps and hollows that require hours of effort and expense to overcome.

Construction of Drags.—The drags or hones used in Connecticut are constructed in our shops and for the most part by the maintenance crews themselves, the average cost being about $35 for each drag. These drags or hones are built of oak timber or timber of equal strength, in order that all weaving or springing may be eliminated, especially when the drag is heavily loaded. They are built either 16 or 18 ft. in length and 8 ft. wide. The side members are made of 6x6-in. or 4x6-in. timbers. There are four cross-members of 4x6-in. oak or ash, set at an angle of 45 deg. to the side members, all cross-members slanting the same way. These cross-members are well bolted and braced to overcome any tendency to spring or vibrate. On the face of the cross-beams are bolted steel blades, specially hardened for the work, these blades being set 1 in. below the cross-beam to give a sharp cutting edge. The drag is very heavily stayed and braced over the top with 2 or 3-in. oak planking, and the braces holding the cross-beams are securely bolted to these planks. This heavy bracing keeps the drag from trembling and causes the blades to cut without springing or slipping. The drags are mounted on iron shoes at each corner, to save the side members when uneven surfaces are encountered and to keep the blades from digging too deep when soft surfaces are gone over or the top is being mulched and depressions are being filled. These drags are drawn by 3½-ton trucks and at times are loaded with one or two tons of weight; when very rough surfaces are encountered even more weight is put on. Many times, when extreme conditions are found, the power of two large trucks may be required to move them over the surface. Our experience has been that the heavy wood drags are to be preferred to the light-type steel hone, as the wood drag seems to have just enough flexibiliy to save tearing the surface and still has the proper shearing action on bumps or corrugations. It also leaves a more uniform and smoother surface. In the dragging of fresh or green bitumen, we have found it to be of great advantage to leave the right-hand side of the cross-beams open. That is, we mount the 6x6-in. side members on top of the cross-beams and thus allow all the mulched material to pass out without clogging the drag. This open-end drag also enables us to smooth down the shoulders and brush all the rough material such as stones, rubbish and weeds off the surface and over the edge of the shoulder and we thus not only keep the shoulders clean and attractive but we build out the shoulder with the material we formerly were obliged to pick up by hand and cart away, which added to the cost of shoulder maintenance.

While we realize that our efforts have not accomplished all we desired, and much study must yet be given to the subject, we do know that our work is now being done more efficiently, that our macadam surfaces are better maintained and that we have effected a great saving in the cost of maintenance. We have, in general, met the demands of the public for a better riding surface and at the same time created a surface that can be maintained at all times in a smoother and better condition.

Acknowledgment. — The foregoing paper was presented at the sixth annual convention of Highway Officials of the North Atlantic States.

Montreal, Quebec, to Spend $8,000,000 on Streets and Sidewalks.—H. A. Terreault, Chief Engineer, City Hall, Montreal, Quebec, has announced the 1930 road improvement program for Montreal; some $8,000,000 will be spent on streets and sidewalks.

Street Cleaning in Toronto

Organization of Department—Methods of Covering Downtown and Outlying Districts —Culvert Cleaning and Flushing

AN outline of methods of street cleaning in the city of Toronto, Ont., is given in the 1930 annual report of the street commissioner, George W. Dies. The duties under the supervision of the street commissioner are, in general, the cleaning of public streets, lanes and thoroughfares; the collection and disposal of ashes and household waste material, the cleaning of catch-basins, the oiling of unimproved roadways and the removal of snow from the downtown section and main arteries.

The basic organization of the department consists of a geographical division of the area of the city into three parts, each controlled by a division superintendent; a fourth division, under the control of the superintendent of incineration, directs the operation of the three refuse disposal plants and the departmental garages.

The geographical divisions are divided into foremen's districts, each of which is subdivided into three sections, representing the days of collection; viz., Monday and Thursday, Tuesday and Friday and Wednesday and Saturday.

During 1929 there were, on an average 1,055 men employed daily in the various services of the department. The refuse-collection service required 35 city-owned trucks, 374 city-owned wagons and 80 hired carts during the peak of the winter season; this was reduced to 25 city-owned trucks, 337 city-owned wagons and 28 hired carts during the summer months. One hundred and ninety-five patrolmen and 52 vehicles were engaged in the street-cleaning service. One hundred and two men were engaged continuously at the refuse-disposal plants.

Divisional Organization.—The divisional superintendents are responsible for the operation of their respective divisions. The execution of the work is entrusted to district foremen. Each superintendent is stationed at the main yard of his division, where the time sheets are prepared, records maintained and reports made incidental to the operation of the division.

Each main stable is in charge of a stable foreman, and each sub-stable in charge of an assistant foreman, who are responsible to the superintendent for the care of horses, feeding, shoeing, wagon equipment and the condition of the stables.

For the performance of street-cleaning work, there are five foremen's districts comprising the downtown business sections, each district with an average of 1,700 acres and 51 miles of streets. The remaining section, comprising ten districts, is under the jurisdiction of the refuse collection foremen, who supervise the work in conjunction with the collection.

Yards and Plants.—There are three main stables and four sub-stables. The main stables and yards are centralized in each of the three divisions. The sub-stables are situated so as to serve the outlying sections and are under the control of the divisional superintendent.

During the year a new yard, designed according to the most modern, sanitary principles, was completed on St. Lawrence St. This yard accommodates 93 horses, with a hospital of four box-stalls so that sick horses may be isolated from the general stable if necessary. Ample wagon sheds were provided, in order that all equipment might be protected from the weather. The entire yard is paved with concrete, with the exception of that portion beneath the north and south wagon sheds, which is filled with cinders. The yard has two street entrances, between which are situated the repairing and shoeing shop, a garage and an office. On the second floor are situated broom-making and harness shops, as well as a spacious men's mess room and a cloak room.

The need has been felt for a modern building, in which could be maintained a construction, wood-working, paint and repair shop, with a modern stockroom and storeroom. This would reduce construction and repair costs materially. The department has at present a rolling stock of 500 vehicles, and it is imperative that this equipment be kept in proper order and repair if any degree of efficiency is to be maintained.

Street Cleaning.—The increasing use of hard-surfaced pavements, the growth of civic pride and the increasing demands for cleanliness and improved health conditions are responsible for the modern problems of street cleaning. The older types of roadways require maintenance work rather than cleaning, except for the occasional gutter sweeping. Improved pavements, however, render street dirt more noticeable and more of a nuisance, but making possible its ready removal with the various kinds of cleaning equipment. Well-paved and well-kept streets are a source of civic pride. They are the most noticeable thing to the stranger. Clean streets are, moreover, necessary to public health.

The extent of the street-cleaning work indicates to some measure its importance. There are 571 miles of streets, 506 miles of which is paved. Three hundred and thirty-two miles of the paved roadway is asphalt, 94 miles bitulithic, 25 miles brick, 20 miles concrete and 18 miles asphaltic concrete. The remainder consists of the older types of roadways, some of which were laid for experiment, and which are gradually being replaced each year with asphalt. This improved street mileage has a total area of 8,137,816 square yards.

The appearance of this vast area depends to a large extent upon the rapidity and system of street dirt collection, as well as upon the degree with which the distribution of litter and rubbish is controlled at its source.

The gradual improvement to roadways each year and the complete change in traffic conditions during the past decade have altered the methods of street cleaning to a large degree, as well as increased the hazard with which the work is performed.

Patrol System.—The patrol system is used entirely in the downtown section, business areas and on main thoroughfares. Each patrolman is provided with a carrier, set of metal tubs, each with a capacity of 3 cu. ft., push broom and scraper. As the tubs are filled, the patrolman leaves them at a designated point to be collected. The streets under the patrol system receive constant cleaning, and may be covered from two to eight times each day, according to the district.

The remaining section is under the squad system, the men working in pairs followed by a pick-up vehicle. The streets under this system are covered once or twice a week.

There are many streets in outlying districts which do not receive the attention they should owing to the fact that the funds available will not permit constant cleaning; these streets are therefore under the squad system and are cleaned once or twice weekly.

The rapidly moving traffic on certain principal thoroughfares conveys all dust and litter into the gutters, thereby reducing the sweeping to gutter cleaning. Here the parked automobile interferes to a great extent with the efficiency of the service. This is particularly noticeable under the squad system, where the sweepers are followed by pick-up vehicles. The sweepings should be removed immediately, but at times while the loaded vehicles are traveling to and from the dump, vehicular traffic scatters it about again, while some motorists run their cars over several piles before stopping. Others park over the pile, thus preventing the removal of it.

The horse-drawn 4-yd. wagon is used for pick-up work in certain sections, while the motor truck is used to the greatest advantage for removing the contents of the patrolmen's tubs. At

some locations there are from four to eight tubs to be emptied, with a total capacity of 18 to 24 cu. ft. In the downtown section a 5-ton motor truck is used for collecting the contents of the tubs.

Street sweepings are disposed of by dumping as land fill. Certain shallow areas are used entirely for street dirt. The heavy cleanings in the spring are dumped in ash and rubbish fills.

Many private applications are received from residents for this material for garden fertilizer, which is delivered free of charge, the department taking advantage of every application, for it means a short haul and a ready disposition for the dirt.

During the fall, when leaves constitute the greatest bulk of the street dirt, difficulty is experienced at the dumps with the vehicles, owing to the spongy nature of the material. The fills are kept as shallow as possible and built up in layers, in order to overcome the vehicles becoming mired. The Parks department and several vegetable and flower gardeners request fall cleanings for compost heaps or leaf loam, which takes care of a large quantity of leaves at this time of the year.

There are, however, many thousands of yards which can be disposed of only by dumping. During the summer of 1929, 98,878 cu. yd. of street sweepings were removed, averaging 12.2 cu. yd. per 1,000 sq. yd. per season. A daily average of 24 4-yard wagons, 22 carts 2 yd. and 2 motor trucks was required in the pick-up service, while 195 patrolmen were constantly in service from April until December.

Table I gives comparative statistics on the patrol service from 1913 to 1929.

Each patrolman maintains an average of 3 miles of street, covering an area of 41,732 sq. yd.

Table I—Comparative Table of Patrol Service, City of Toronto, Ont., 1913-1929

Year	Number of Patrolmen	Labor Weekly Wage	Expenditure	Street Mileage Improved	Street Mileage Total	Population
1913	428	$13.50	$270,653	336.47	521.53	445,575
1914	422	15.00	301,377	337.70	529.69	470,144
1915	395	15.00	301,787	359.21	530.24	463,705
1916	380	15.00	282,448	369.60	530.47	460,526
1917	192	18.00	183,111	372.10	530.63	473,829
1918	158	$20.00 / $21.00	174,914	387.16	531.03	489,681
1919	215	24.00	253,442	384.61	531.03	499,278
1920	228	28.80	352,151	407.32	539.63	512,812
1921	190	28.80	308,155	401.34	545.89	522,942
1922	200	28.80	319,107	406.37	548.99	529,083
1923	130	28.80	222,868	430.71	556.17	538,771
1924	130	28.80	226,991	446.41	558.83	542,390
1925	158	28.80	625,851	458.82	559.94	549,429
1926	167	28.80	251,787	467.47	561.68	556,691
1927	175	28.80	262,939	477.02	562.16	569,899
1928	190	28.80	277,866	480.70	564.40	585,628
1929	195	28.80	270,399	506.30	571.30	606,370

The department has under consideration the advisability of using mechanical sweepers in night service in certain residential and semi-business districts, which districts are at present receiving only one cleaning a week, in order that a more frequent and efficient cleaning may be given. These sweepers would cover districts now operating under the squad system, and release the men for patrol duty in congested and business districts.

The tabulation below gives the unit-cost of hand-broom sweeping of improved roadways for 1929:

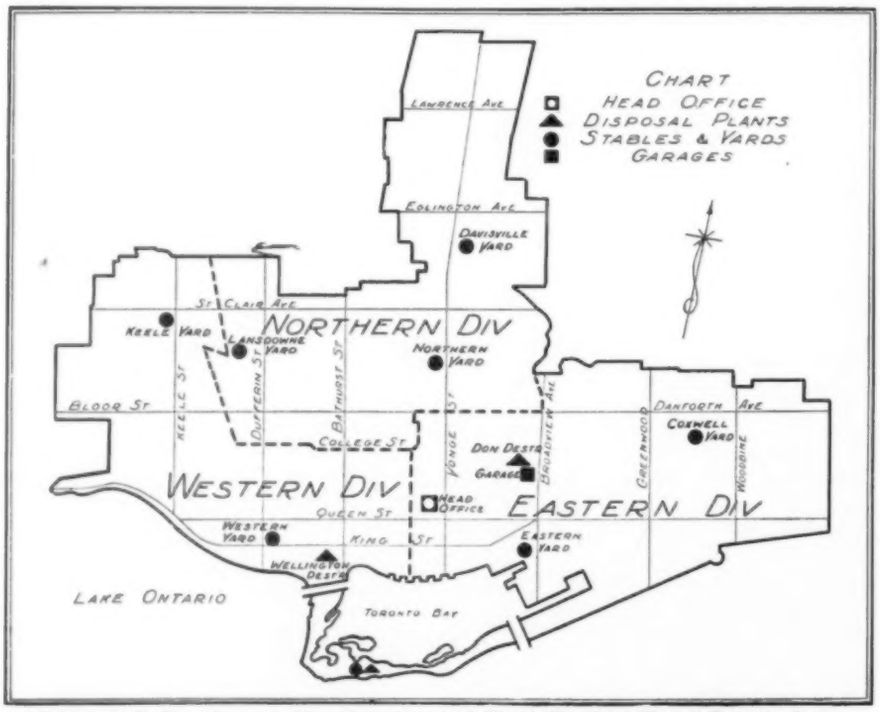
Total cost (foremen, labor, cartage, supplies)	$270.399.00
Area of improved street milage (sq. yd.)	8,137,816
Cost of maintenance per 1,000 sq. yd. per season	$33.23
Amount of sweepings collected (cu. yd.)	98,878
Cost per cu. yd. (sweeping, collecting and removing)	$2.73
Cubic yards removed per 1,000 sq. yd. per season	12.2
Number of patrolmen	195
Average area maintained per patrolman (sq. yd.)	41,732
Average number of times swept per season	90
Cost of sweeping per 1,000 sq. yd. (sweeping, collecting and removing)	$0.369

Flushing.—During the past five years, street flushing has been reduced to a minimum, due to insufficient funds being available to carry on the work. It is a very essential service, and is closely associated with the patrol service. Flushing is the best means of removing the fine dust that escapes the patrolman's broom, and which would otherwise be left to the mercy of the winds, to the general discomfort of pedestrians.

It is anticipated that a regular flushing schedule will be adopted for the coming season. The department has six power-flushing units, and two electric flushers that may be placed in operation. The best results are obtained by night flushing, and the operation of the flushers in pairs. By this method there is a minimum of interference with traffic, and a greater efficiency by working the flushers in pairs. In this way the dirt becomes thoroughly wet and loosened, so that it may be readily washed into the gutter by the second flusher.

The general building activities during the past summer warrant that definite action be taken to alleviate the dust nuisance throughout the area where extensive building construction is being carried on. Invariably the route of travel of the dump trucks from excavation is in a deplorable condition due to falling of mud from the wheels and overloading of the trucks. This material is soon ground to fine particles by traffic with the result that each passing vehicle raises a cloud of dust. The contractor is concerned only with the removal of excavation material and gives no thought to the nuisance that is being created. It is therefore necessary to take action against persistent offenders and keep all such works under constant observation.

The department had in operation last season two electric flushers and one gasoline flusher. The electric flushers were confined to night flushing in the downtown sections lying between Simcoe St. and Sherbourne St., south of Dundas St. The district was divided into two sections, the streets receiving a flushing on alternate nights.



Divisions, Stables, Garages, Etc., Department of Street Cleaning, City of Toronto, Ont.

Organization and Authority of a Highway Materials Division

Control of Materials Entering Construction Equally Important as Testing—Authority Commensurate with Duties Necessary for Best Results—Cooperation with Producers, Field Engineers and Executive Departments Secret of Success in Pennsylvania

By H. S. MATTIMORE

Engineer of Tests and Materials Investigation, State Highway Department of Pennsylvania

WHEN we discuss a testing laboratory of a highway organization, we should include more than the organization occupied with the detailed testing of materials. The testing operations are vitally important, and are really the basis of organizations; in other words, we actually have to determine the quality of materials before we can anticipate what

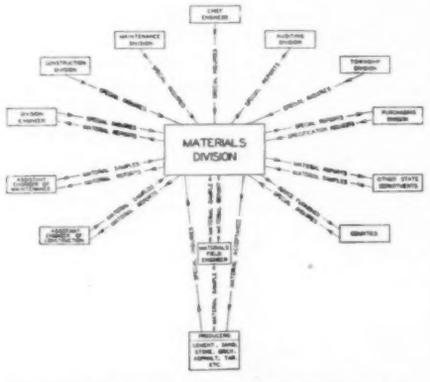


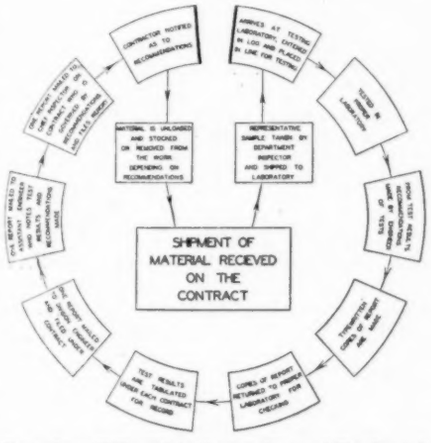
Diagram Showing Relation of Materials Division with Other Divisions of Department, Other Departments of State and Counties—Pennsylvania Department of Highways

their service value will be after fabrication, but another factor of major importance is the control of materials that are actually being used. Taking this into account, and in recognition of the increase in scope and authority of testing divisions in the highway field, there has been a tendency to change the name of this division to a materials division, as such a title is more inclusive of the operations.

The original testing divisions of highway organizations were modeled after commercial and product laboratories. These organizations in the main were for the purpose of ascertaining quality of materials, and to control the product manufactured at the mill, or to furnish information relative to material qualities. The status of the original laboratories was not comparable to other divisions of the organizations. The scope and authority were undetermined, and as a general rule, although looked upon as one of the essential parts of the organization, the authority and status were such that the full amount of service could not be obtained from this division. Now I believe we are at the stage where we recognize what can be accomplished by a materials division, and a suitable status should be given to this organization in recognition of its service and accomplishments.

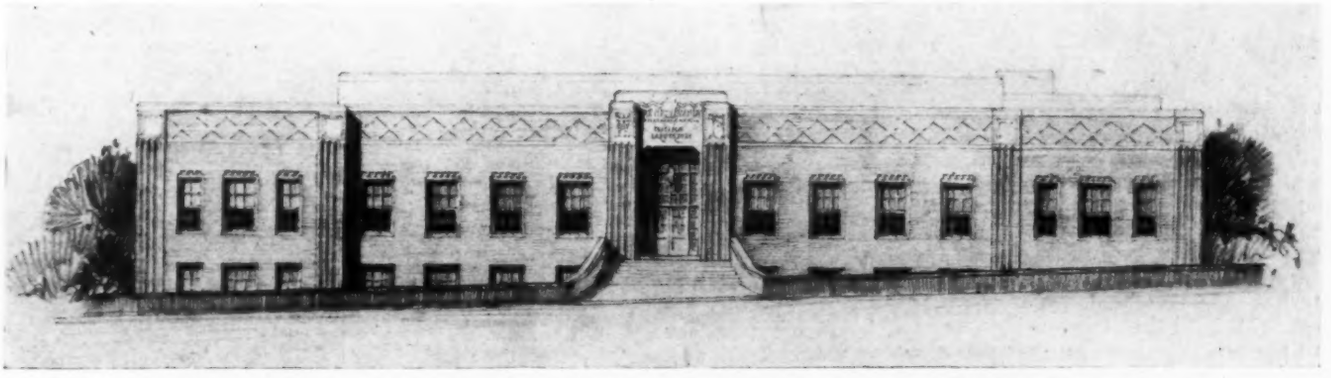
Estimated Cost.—The kind and type of organization to control the materials used in construction will in a large measure be regulated upon the amount expended by the main organization. In other words, state highway departments with large annual expenditures will necessarily have a more extensive material control organization, with a larger operating expense than organizations with smaller annual construction programs. It is rather difficult to designate what the proper cost should be for a material control division. Where such a division operates with full responsibility for the control of materials, and carries on sufficent research work to guide the field in proper use of materials, an expenditure of five-tenths per cent of the construction cost is fully warranted. This would not necessarily include large research projects. Such projects should be financed under a separate appropriation.

Status.—A well organized highway



Procedure Followed in Inspection and Testing of Materials, Pennsylvania Department of Highways, Showing Routing of Material and Handling of Report and Recommendations

testing or materials division should have sufficient authority to ascertain the quality of materials which are to be used in construction under its supervision, and to assure the use of materials meeting the specified quality. This would include the supervision of sampling of all materials and testing operations, recommendations relative to the use of materials and proper control of materials which are actually



Front Elevation of New Laboratory Building Now Under Construction for Pennsylvania Department of Highways

CEMENT ACCEPTANCE REPORT

Pennsylvania Department of Highways

No. 107

Date Sept. 5 1929

The contents of this car Rdg. 54731 of cement from Lehigh Port Cement Co. Company has been tested, accepted and loaded under the supervision of PENNSYLVANIA DEPARTMENT OF HIGHWAYS TESTING LABORATORY for use on Route 443 County Lehigh Contractor D.L. Risser Amt. 231 Bbls. Seal Numbers PDH- S-4064-A S-4063

H. S. Mattimore

Per T. Bennett

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF HIGHWAYS
CEMENT BIN RECORD

Brand of Cement Lehigh P.C. Co. Bin No. 12A Approved August 27-1929
Capacity 5000 Bbls. Date Sept. 5 1929

Cement Acceptance Report No.	Car Initials and Number	County	Route and Section	Contractor	Previously Shipped This Bin 1730
107	Rdg. 54731	Lehigh	443	D.L. Risser	231
108	PRR 813521	"	"	"	289
109	LV-6432	"	"	"	200
				Total Barrels Shipped -	2450

Signature T. Bennett

Form No. 4138
Commonwealth of Penna. Department of Highways
RECORD OF SHIPMENTS OF PORTLAND CEMENT
Route No. 443 Section
County Lehigh

Contractor D.L. Risser

Date	Brand	Bin No. or Lot No.	Car Initial and Number	Bbls.	Permanently Stored Time	Remarks
9/5	Lehigh P.C.Co.	12A	Rdg-54731	231	O.K.	
9/5	" " "	"	PRR-813521	289	"	
9/5	" " "	"	LV 6432	200	"	
9/6	" " "	"	Rdg. 14813	231	"	
9/6	" " "	"	Rdg. 34925	173	"	
9/8	" " "	7B	PRR-713577	250	"	
9/8	" " "	"	Bal. 16341	200	"	
9/10	" " "	"	Rdg. 24762	231	"	

Cement Acceptance and Recording Forms, Pennsylvania Department of Highways: (1) Cement Acceptance Report, Placed in All Cars After Material Has Been Loaded from Approved Bins; (2) Cement Bin Record Kept by Plant Inspector; (3) Record of Cement Shipments on Individual Contracts

used on the contract. This organization should be also the source for all material specifications, and should supervise all investigations where materials or quality of mixtures are a factor.

In order properly to function in the operations stated, the materials division should have a status equal to other divisions of the department, such as construction, maintenance, purchasing, auditing, etc., from the standpoint that cooperation is required from these other divisions, and such cooperation can be more readily secured when the divisions are on somewhat of an equal status.

It must be recognized by the materials division that authority includes responsibility, and that the extent of their authority and rated status will be regulated in accordance with how they meet their responsibility. The type of men responsible for the organization and functioning of the division must have the proper training, sufficient executive ability to meet the responsibilities and personality to command respect of all the divisions of the department and outside agencies with whom they come in contact.

Contract with Producers and Construction Engineers.—In field operations the materials division's employees are constantly coming in contact with material producers; these producers' business depends upon the use of their product. The engineers from the materials division have a responsibility to see that this product meets the specified quality. You can readily see how such connections might ocasionally lead to difficulty and argument. If the material producer has confidence in, and respect for, the employees of the materials division, these controversies are minimized, while improperly trained employees, careless in operations or decisions, may get the whole highway organization into controversy.

In functioning as a material control organization, the employees of the materials division come in close contact with the engineers in charge of construction, and one of their functions should be to train construction engineers in field tests of materials, and the interpretation of materials specifications. My experience has been that the construction engineer is vitally interested in producing work of high quality. What lack of interest I have found among field engineers was mainly due to the fact that they did not recognize the importance of material qualities as a factor in the quality of the work, but as soon as this had been properly presented, the right kind and type of construction engineers not only showed an interest, but were of great assistance to the materials division.

Testing Organization.—For discussing a detailed organization, I wish to describe briefly the organization in the Pennsylvania State Highway Department, which has functioned in a successful manner for a number of years. The main testing laboratory is divided into four divisions: chemical laboratory, physical laboratory, sand and cement laboratory and clerical division. It was found advisable to separate the sand and cement laboratory from other physical operations, such as steel, concrete, etc., as the sand and cement testing are strictly specialized operations, and there is a large amount of work of this kind.

Each section, or laboratory, is held responsible for results submitted. After test reports have been typed, the report is returned to the laboratory from which it originated for check. This procedure is very important, as inaccurate reports might cause unnecessary financial losses. Also, the head of each laboratory is required to be familiar with the specifications of all materials for which he is responsible for the tests. This is of great assitance to the head of the laboratory, or his assistant, when basing recommendations for the use or rejection of these materials.

Prompt Report on Tests.—Probably one of the main criticisms I have heard against many testing laboratories is a delay in submitting results of tests. I know many of these are not justified, from the standpoint that the critics are not familiar with the time required for testing operations. We try to avoid such unfair criticisms from the field by tables inserted in our instruction book to inspectors which definitely state the time necessary for test operations on different products. In cases that I have known where the criticism in delay in results was warranted, it was mainly due to the fact that the organization was not capable of meeting peak conditions. Such a lack in organization

Form No. 4139
Commonwealth of Pennsylvania Department of Highways
CONTRACT REPORT OF MATERIAL INSPECTION
County Adams Route No. 123 Appl. No. — Section No. 2

Date Aug. 13, 1929 Contractor General Const. Co.
District Inspector Chief - Miller Mixer - White Plant - Lehman
Type of mixer Koehring 27E Finishing La Verwood Screed
Progress Ave. 550 daily of 24'x7"-20c Pvt. Thickness 12½ Prop.

Materials

Kind	Producer	Amount on hand	Condition	Remarks
Cement	Sandusky P.C.Co.	1200 bbls.	O.K.	Lab. Test.
Fine aggregate	Arundel Corp.	863 Tons	"	Field Test.
Coarse aggregate	Bethlehem Mines	870 "	"	" "
Reinforcement	Truscon Steel Co.	90 %	"	Lab. Test.
Water	Pine Creek Stillpool	Sufficient	"	" "
Expansion joints	Philip Carey	78 %	"	" "
$CaCl_2$	Dow Chemical Co.	100 %	"	" "

Construction Details

Handling materials Unloaded from cars to stockpile by clamshell. Stockpiled properly on plank, with edges protected. Stone sprinkled.
Measuring Erie weighing plant. Checked daily with calibrated weights.
Mixing Mixer equipped with $CaCl_2$ measuring device, speed of mixer - 18 R.P.M. Time of mix 60 seconds.
Consistency Medium mix. Slight variation noted.
Placing Subgrade sprinkled. Steel placed properly. Sides and center spaded.
Finishing Pavement screeded from 2 - 2 Times. Pav't. straight edged. Center and edges neatly finished.
Curing Double thickness saturated burlap placed longitudinal for 24 hours. $CaCl_2$ Cured.

Instructions to Inspectors

Item	Sampling	Field testing
Fine aggregate	all tests	Plant inspector familiar with procedure.
Coarse aggregate	" "	" " " " " "
Concrete being weighing Plant	Instructions	Chief and mixer inspc familiar with procedure.
	"	Chief and plant " " " "

Time spent on contract 2 days
Accompanied by Asst Engr. H.C. Wells
Remarks- See reverse side of report

John Doe

NOTES

FORMS:- Blaw-Knox NEW staked 100'ahead of mixer
SETTING:- Compacted 12" with 30 pound Tamper.
SUBGRADE:- RED SHALE
CONDITION:- Compacted, free from loose material
$CaCl_2$ MEASURING DEVICE:- Burnet System
$CaCl_2$:- Ave. 2% over run
$CaCl_2$:- Sp. Gr. - 1.330
CEMENT FACTOR:- 3.00 bags per lineal foot of pavement
CEMENT:- Ave. 4% over run.
WATER CONTENT PER BAG OF CEMENT :- 4.92 Gallons

WEIGHING PLANT CHECKED

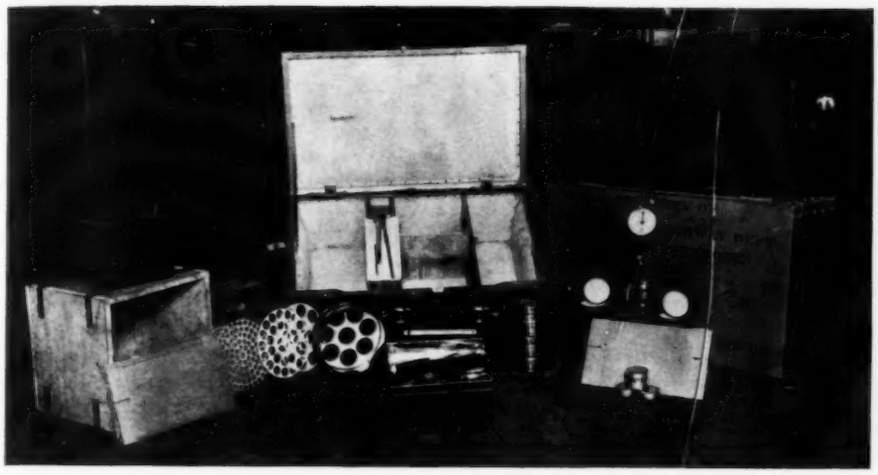
WTS applied lbs	Scale Reading lbs	Variation lbs	% Var.
528	527	1.0	0.2 %
1028	1027	1.0	0.1 %
1528	1526	2.0	0.13 %
2028	2027	1.0	0.05 %
2528	2528	0.0	0.0 %
3028	3029	1.0	0.03 %

WASH-OUT TEST RESULTS

	Sand	Stone	Total
Pounds of aggregate found:-	13.613	24.313	38.250
DRY: " " " :-	13.613	24.071	38.546
% " " " :-	35.99%	64.01%	100.0 %
	Cement	Sand	Stone
Required mix:-	1	2.00	3.50
Actual mix:-	1	1.98	3.82
% variation :-		-1.0%	+9.57%

GENERAL :-
Series "6 Beams Tested during visit - Ave Results - 570 lbs
Series "7 Beams moulded during visit of Station 601+35
Dowel bars anchored and clipped.
Small amount of honeycomb found.
Slight hairchecking found on previous days run.
Transverse Expansion Joints opened and cleaned.
Stations and high spots painted on pavement to date.
Mixer drippings removed from subgrade.
Center line steel placed 75' ahead of mixer.
Some forms found, that were leaning. All form keys not tight.

Report of Field Engineer on Contract Inspection, Pennsylvania State Department of Highways



Equipment for Plant Inspector on Bituminous Surfacing

should not exist, from the standpoint that it is false economy to save a few additional men and at the same time cause extensive loss in field operation. We have established a rule, and very rarely make any exceptions, to have the tests started on all materials the day that they are received.

Cement Control.—In order to give more prompt service on plant controlled products, we have two branch laboratories, situated at Allentown and Pittsburgh. The Allentown branch laboratory is chiefly concerned with cement inspection and tests, while the Pittsburgh laboratory force has supervision of inspection and testing of cement, steel and brick, and periodic inspections of sand, gravel and slag in assigned territories. Twenty-four-hour tests on cement are made at both of these laboratories. We have found that our control of cement is thorough enough to allow cement to be shipped from approved bins on the basis of 24-hour tests. This privilege is based on the results of 7 and 28-day tests previously made on the products, and in cases where cement does not consistently meet the 7-day requirements all acceptances are made on the 7-day basis. The privilege of the 24-hour acceptance is a very desirable one to the cement companies, and cases are extremely rare where a company loses this privilege, from the standpoint of not meeting the 7-day requirements.

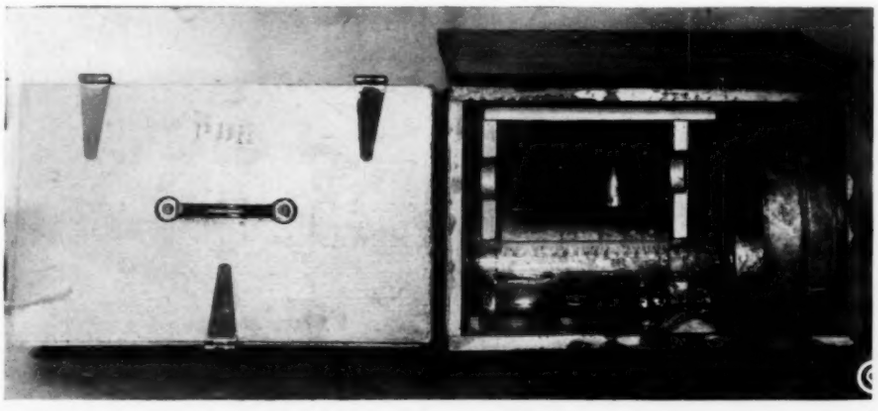
We consider that sampling, testing and inspection of cement are very important operations. We not only require that the samples be taken by our own inspectors, but we insist that the inspectors be present during the loading of cars from accepted bins. These cars are shipped under seal, and contain an acceptance card which is the authority for the use of the material when it arrives at the site of the work. These acceptance cards are numbered, and the supervising inspectors in charge of the work at Allentown and Pittsburgh laboratories are responsible for the use of such cards. In the same way they hold their inspectors to the same responsibility, and each card has to be accounted for. Although the preliminary tests on cement from a large majority of the companies are made at the branch laboratories, a part of this sample is forwarded to the main laboratory in Harrisburg for check tests. This check testing we believe is a safety provision both for the cement companies and the highway department.

Aggregate Control.—Paving brick and a large amount of reinforcing steel are tested at the plant, but fine and coarse aggregates are controlled by field tests at destination, after materials produced from the source have been accepted on the basis of laboratory quality tests. Some organizations have found it advisable to assign inspectors to aggregate plants to sample the material during loading, and accept before shipment. This is not an economic or practical procedure in the state of Pennsylvania, due to the large number of aggregate plants. It would be difficult to secure sufficient competent inspectors for this line of work, since there is very little incentive for future promotion for such a large force; also economy would require that this force, or at least a large majority of the men, would be employed only during the construction season.

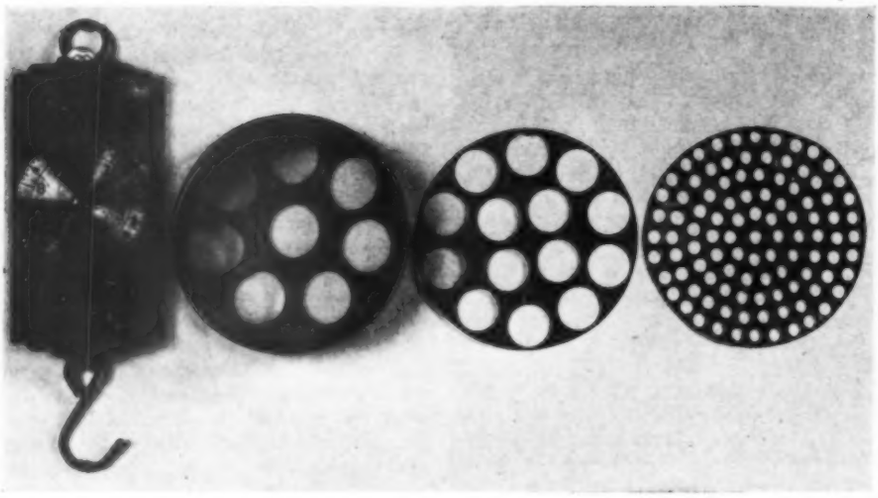
We realize that we have a certain responsibility in assisting the production plants, and from this standpoint our field employees from the laboratory make periodic inspections at these plants, these inspections being regulated by the quantity and quality of the materials shipped. In cases of a number of rejections in shipment from one plant, one of our field engineers visits this plant to study the conditions, and to give recommendations for correction. This method of inspection of aggregates has worked out very successful, but some of the success is due to the fact that the material producers realize that they have to assume a part of the responibility for obtaining the proper materials. Many of them, especially the larger plants, have installed their own inspection division where tests are made on materials prior to shipment.

Qualification for Employees.—The detailed operations in the testing laboratories are of considerable importance, but this branch of work has been so thoroughly standardized that very little can be suggested. One point that might be emphasized is that a large number of laboratory operations require some technical skill and training, and employees should be carefully selected. In cases of laboratory assistants doing the minor class of work, the selection of employees is still an important item. Although we have no civil service in the state of Pennsylvania, we do have a classification system, and all assistants in the laboratory must at least have a high-school training. The technical employees in charge of laboratories, or important operation in these laboratories, must have a college training or equivalent. In the selection of field engineers consideration should be given to specialized training and personality.

The testing division is called upon to furnish specifications for the purchase of small equipment and supplies for use by the maintenance or other divisions. This is a field that is not usually associated with highway building and maintenance. The division also cooperates with the purchasing divi-



Equipment Box for Plant Inspectors on Concrete Construction, Including Equipment for Field Testing of Coarse and Fine Aggregates

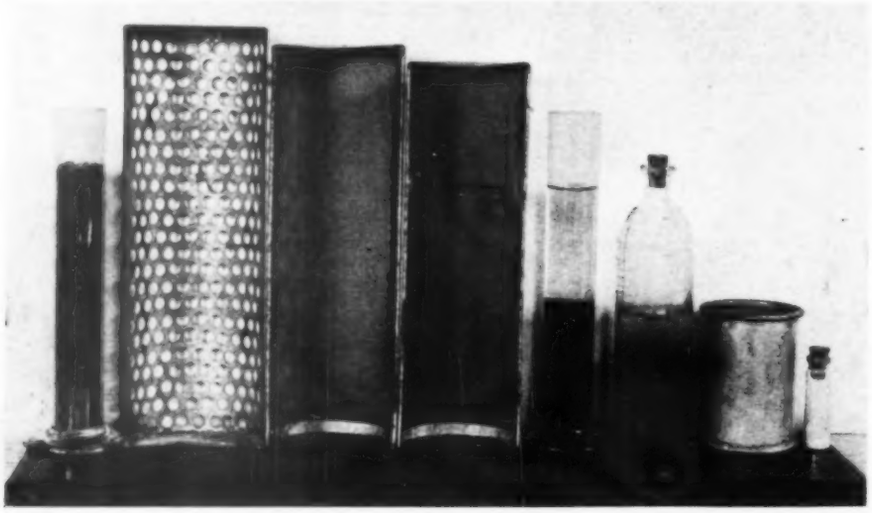


Detailed Equipment for Field Testing of Coarse Aggregate

sion in the furnishing of specifications for these materials, and with the auditing division in advising when materials meet specifications so that payments can be made. Where this cooperation is close and the quality of materials purchased is well controlled, it has been found to be a very economical procedure in control of expenditures.

Field Tests and Inspection.—One of the operations which is now well established as an adjunct to the testing division, is the material control in the field. No highway department can be fully assured of the quality of the materials used unless this control is centralized. Many views have been expressed relative to the advantages or disadvantages of centralized control of engineering operations in the highway field. Regardless of what the opinion is, relative to other operations, I feel assured that such centralized control is absolutely essential for success on material work. The interpretation of specifications and detailed field testing must be standardized throughout the entire department; otherwise there is no surety that material qualities will be the same in all divisions and sections, and when such conditions exist contracts could not be let on an equitable basis. Also, the material producers could not compete in different sections of the state on the same basis, unless this control was centralized.

Under present standards of highway construction methods, material deliveries and proportioning plants are usually at the same location. One or more inspectors stationed at this site should be held responsible for material inspection and proportioning. These inspectors may or may not be directly under the supervision of the testing division. In our organization the plant inspectors are employed by and work under the supervision of the division engineer in charge of construction. This procedure has advantages; for instance, the position of plant inspector can be made a stepping stone to higher inspection or engineering positions in the field. Also, the construction engineers are directly responsible for the work of the plant inspector, which furnishes additional incentive for their interest in material qualities.



Detailed Equipment for Field Testing of Fine Aggregate

Although a plant inspector is employed by and working under the supervision of a division engineeer in charge of construction, he is trained and instructed by the field engineer of the testing division. At the time the field engineer from the testing division visits the contract, he is accompanied by the assistant engineer in charge of one or several projects, and the engineer in charge of the contract; and although the plant inspector performs the actual operation of testing and inspection, the engineer or inspector in charge of the contract has to approve all material reports, and thereby assumes responsibility for them.

The field engineer from the testing division, although specializing on materials, is well informed on construction methods. One of his duties is to make a complete report on the operations of the contract, especially such operations that affect quality; for instance, on a concrete highway, subgrade condition, mixing conditions, concrete consistency, curing, etc. These reports have proved very valuable to the department on investigations of contracts where the quality of the finished product was in question.

When concrete field tests are made on the contract, such as is the practice in our work with flexural tests, the field engineer from the testing division instructs the field forces in the fabricating of the specimens and the methods of making the tests. He also personally makes specimens and performs tests for the purpose of checking. Further than this, if it is noted from field tests and other reports received in the main laboratory that the quality of concrete is not up to the standard, one of the field engineers from the testing division is assigned to the work for investigation.

Interpretation of Specifications.—We occasionally hear the expression that broad interpretation of specifications is necessary on all contract work; in fact, I have heard it stated that no contract could be finished at a profit if specifications for the work were literally interpreted. In answer to this I would say that where such specifications exist they certainly require changing, in that it is better engineering and a safer procedure to state what will be actually required in construction than deliberately to specify requirements which require broad interpretation. In regard to material specifications, the only tolerances allowable would be on prepared natural aggregates to allow for difference in testing operations, which is usually such a small amount that it is seldom required to be used for materials properly prepared and tested by trained operators.

Executive Cooperation.—The successful operation of materials control as described, depends to a large extent on sincere cooperation on the part of the executive departments and the field forces. The materials division must

simplify the operations required in the field as much as possible. Some of the present methods proposed for control of concrete in the field at the present time, although labeled as simplified methods, are complicated in operation, requiring considerable increase of work and placing additional responsibility upon the field man.

Our success in handling material control in Pennsylvania we attribute in a large measure to the sincere cooperation secured through the executives and the engineers on construction. For instance, the attitude of the executive department has been that all matters relating to materials must be discussed and decided in conjunction with the materials division; thereby establishing a status and authority for this division.

Acknowledgment.—The foregoing is a paper presented at the Syracuse meeting of Highway Officials of the North Atlantic States.

Greater Activity Needed Over Nation's Entire Road System

PROMISCUOUS building of superhighways is shown to be ill-advised in a summary of traffic statistics dealing with highway planning issued on April 6 by the American Road Builders' Association. Instead, the association finds need of greater activity over the entire network of the nation's roads, with all construction preceded by a careful survey of the present traffic facilities and its future requirements.

Regional planning is urged for all centers of traffic density. Such planning would indicate whether present roadways should be reconstructed to great width, or whether the construction of more arterial highways over new routes would be most advisable.

Over the majority of state and county highway mileage, a two-lane surface, of 20-ft. width, is thought to offer adequate provision for traffic of the next 10 or 15 years. A right-of-way of 100 ft. is favored and this would permit of eventual widening of the traveled way.

The summary was made from a nation-wide survey of rural and metropolitan traffic areas, traffic origins and concentration, roadway widths and rights-of-way and light and heavy vehicle traffic.

It was found that the necessity does not exist at the present time for the construction of systems of wide highways throughout the country. Except in comparatively small areas, such volumes of traffic do not now exist and will not during the next 15 or 20 years, at least.

In a state as a whole there is no necessity, therefore, of planning an ultimate right-of-way in excess of 100 ft. or a roadway surface width in excess of 40 ft. whether a single or dual strip pavement is involved. On the great majority of the mileage, for a long period of years, even these widths will not be required.

This statement is based on the existing traffic and predicted future traffic on the state and county highways of Wisconsin, the northeastern section of Illinois, Ohio, Pennsylvania, Maryland, Virginia, Connecticut, Vermont, New Hampshire and Maine. The highways in these areas form a cross section of the highway and traffic conditions in all states.

Four years ago in Ohio there were approximately 11,000 miles in the state highway system of which only 131 miles were carrying more than 2,500 vehicles per day, including passenger cars, motor trucks and motor busses. The same relative conditons are found in other areas.

The proportionate mileage carrying a volume of traffic requiring extraordinary pavement widths and design is limited to comparatively small areas, around the larger cities.

If the traffic trends based upon the last 12 years are any indication of future growth it can be safely said that on the bulk of the state and county highway mileage, during the next 10 or 15 years construction can be largely confined to the provision of two-lane surfaces.

A two-lane surface, 20 ft. wide, will carry 8,000 vehicles a day at a speed of 30 miles an hour. These figures take into consideration the normal amount of motor truck and motor bus traffic and are based upon actual research studies dealing with traffic volume, traffic speed and pavement width.

Pavement widths are thought of in terms of traffic lanes with general agreement on the 10-ft. lane as standard. Odd numbers of lanes are falling into disfavor.

Reasonable standards of width of rights-of-way are considered as follows:

Local roads, two lanes for traffic, plus parking, 66 to 86-ft.; primary and secondary trunk lines in well-settled communities, four lanes, plus parking, 100 ft.; primary highways, six lanes, plus parking, 120 ft.; superhighways with provision for high-speed motor traffic separated from local traffic, 10 lanes and four parking strips, 200 ft.; special snow-belt trunk highways, two lanes, with provision for permanent snow fence and protective planting within the right-of-way, 150 ft. to 300 ft.

Asphalt Institute Elects Officers

The newly organized Asphalt Institute, which succeeded The Asphalt Association on Jan. 1, last, has elected the following officers for the fiscal year 1930: Leroy M. Law, St. Louis, Mo., president; W. H. Kershaw, New York, N. Y., vice-president; C. W. Bayliss, Philadelphia, Pa., vice-president; B. L. Boye, New York, N. Y., secretary, and Fisher Jones, New York, N. Y., treasurer; J. S. Helm of New York is chairman of the executive committee and J. E. Pennybacker, also of New York, is managing director.

The Institute has moved to the new Crystal Bldg., 250 East 43rd St. and 801 2nd Ave., New York, where it has leased, for five years, the entire 18th floor. Larger general offices and a new and larger laboratory will be installed in these quarters, with F. C. Field, assistant chemical engineer, in charge. The entire research division will be under the supervision and direction of the Institute's chemical engineer, Prevost Hubbard, formerly chief of research for the United States Bureau of Roads.

In its new quarters the Institute will occupy more than twice its present amount of floor space. The personnel is to be expanded and the activities of the Institute extended to cover education and research in the use of asphalt for roofing, insulating and waterproofing as well as paving.

B. E. Gray, formerly of the West Virginia State Highway Department and the United States Bureau of Public Roads, becomes director of the highway engineering division, succeeding W. E. Rosengarten, who resigned recently to accept a position with Day & Zimmerman in Philadelphia. Mr. Gray, who is widely known among the highway engineers of the country, entered upon his new duties March 20, last. A new man also has been added to the laboratory staff, in Henry Krieger, who becomes assistant to Mr. Field.

The probabilities are that the 9th annual Asphalt Paving Conference, to be held under the auspices of the Asphalt Institute, will be held in October, 1930, at Washington, D. C., just preceding the International Road Congress and simultaneous with conventions of other organizations identified with the road-building industry.

Reasons for Accidents.—Careless driving and speeding were responsible for 11 out of 16 automobile accidents in New Mexico during February. In these accidents, 4 were killed and 17 injured. Of the automobiles, 2 were entirely wrecked and 11 badly damaged. Defects in the vehicles caused 2 of the accidents. All except 3 of them took place upon good roads.

Concrete Pavement Maintenance

Methods Followed on the County Road System of Oakland County, Michigan

By E. J. VAUGHAN

Maintenance Engineer, Oakland County Road Commission

IT has been difficult to prepare a paper dealing with the maintenance of concrete pavements without getting off onto the shoulder of the road. In the beginning, maintenance work was confined to the traveled portion of the roadway only. Little by little we have been reaching out until our activities have arrived at the right-of-way line fences. Few of our maintenance operations pertain to concrete maintenance alone; yet, nearly every one of these operations can apply to pavements, as well as other types of road surfaces. At this season of the year, with recent experiences fresh in mind, it seemed appropriate to begin this discussion with some reference to snow and ice removal. The temptation to do so was too great to resist, even though these are activities that are equally necessary on all types of road surfaces.

Snow and Ice Removal.—Winter brings two of the most grievous things with which maintenance has to contend; namely snow and ice. I do not refer to the actual operations of removing snow, and sanding or removing ice; for these are merely questions of adequate organization and equipment. The grief comes in deciding just when to start in on such work. Either of these two operations are costly unless every move is made to count. It begins to snow during the day. By quitting time it is still snowing; yet not enough snow has fallen to warrant putting out the plows. Will it stop by 8 p. m. or will it continue on through the night? Will it remain calm, or will we get a drifting wind? Will morning find only a moderate amount of evenly distributed snow on the roads, or will they be plugged with drifts? Shall the men be sent home for the night, or directed to report back at 9 p. m., or at midnight?

Or it may be a matter of ice. We get up any winter morning and find all pavements ice coated; or they may become sleeted over in an hour during the day. Immediately we begin sanding sharp turns, dangerous curves, difficult hills, busy intersections and all railroad grade crossings. We get that done. Now, what about the straight-away stretches? Will the sun come out, and will the ice be dissipated by afternoon, or will it stay on for days or weeks?

We seriously began clearing our roads of snow less than ten years ago. Today, with ice, we stand just where we stood regarding snow when snow removal was first considered. We're sort of waiting around to see what the other fellow is going to do. Ice is taking a heavier toll in deaths, serious injuries and property damage than snow ever did. For the past winters in southern Michigan an increasing amount of the total charged against snow removal has really been for sanding ice or light traffic packed snow falls which turn into ice. Yet, even though it has already been costing some southern counties more to make ice roads safer at the most dangerous spots than it has for all their snow plowing; we have not tackled the matter of level, straight-away stretches in a straight-forward, serious manner.

A road blocked with snow means that motorists will have to wait till the snow plows come through. A cleared road, sheeted over with ice is an invitation to a driver to come on out and get killed, injured or have his car wrecked. It is going to be either one of two things, and the decision rests with road officials. When highways are icy, either the public uses them at their own risk, or we shoulder the responsiblity and announce that we will remove or sand ice so that all roads will be reasonably safe for traffic.

In snow storms, in any case of a reasonable doubt as to whether plows should be started out at once, or whether they should be held back; a policy of putting them out AT ONCE will, in the long run, be the most economical. Over-cautiousness will inevitably result in truck repair bills from bucking snow drifts that will not be necessitated if snow is plowed with the storm. If we are to be guided, in snow removal by a paltry matter of dollars and cents, certainly in the case of ice it should be attacked even more vigorously when, in addition to the argument of the loss in property damage to tax payer's cars on icy pavements, we add the extremely likely liability of serious injuries and deaths.

Filling the Center Joint Crack.—Usually the first actual maintenance required on a new concrete pavement is the tarring of the center joint crack. This should be done as soon as enough crack develops to be readily followed with a pouring can. The pavement thus receives a safety stripe down the center for dividing traffic, and future spalling of the crack is prevented. Trouble has been experienced, in the past on heavy traffic pavements, due to tar on the center point ironing out and spreading coincident with the arrival of summer temperatures. This produced an unsightly effect and resulted in the tar becoming so thinned out that it rapidly wore off.

We have eliminated this trouble by substituting fine slag for sand as a cover material. We use slag from ¼ to ½ in. in size. The use of this more expensive cover brought about a change in applying it. Instead of casting the cover on the freshly tarred center joint with shovels, our shop men devised an ingenious contrivance which, briefly, may be described as a two-wheeled wheelbarrow. This barrow has an opening in the bottom which can be enlarged or diminished as required. Cover material drops through this opening onto a belt which is operated by the movement of the two wheels. With the wheels straddling the freshly poured joint and close on the heels of the man pouring, all cover material can be deposited from the wheelbarrow directly on the fresh tar; the amount poured out can be well regulated and waste almost altogether eliminated.

We thought that the large particles of slag would prevent the tar from being squeezed out flat. It has done that; and, we have obtained other benefits unlooked for. One of them of itself well worth the extra cost of the slag, namely: the added safety in night driving, particularly when it is raining. I have not seen any form of center marking that approached the slagged stripe for visibility under such conditions. By day, the appearance of this stripe is a mottled grey and black, quite arresting, yet harmonious with the concrete surface.

Furthermore, remembering that all this refers to the center joint only, three men and a truck driver are covering an average of a mile and a half more of center joint in ten hours than we used to do with five men and the driver.

So long as felt expansion joint material in cross joints protects against spalling, tarring is unnecessary. All joints and cracks should be tarred as soon as there is any chance or tendency to spall.

Whether asphalt or tar be used for this work is a matter of individual opinion. Each material has its good and bad points. Each of them have played, are still playing, and will continue to play their important and valuable part in road work, both in construction and maintenance.

Center Striping.—A question could be raised at the statement that tarring of the center joint is usually first actual maintenance required on the pavement. What about painting a

black asphalt stripe down the center? From experiments tried out in Oakland County it would seem that traffic reaches a point such that results obtained from this work are not worth the effort. Some of our pavements are so discolored from oil drippings from the thousands of cars which daily pass over them that there is not sufficient contrast in color when a black mark is applied. This heavy traffic also mitigates against getting a good result by tracking over and smearing the material before it has a chance to set up; and, once opened to traffic, we cannot consider closing such roads while this work is being done.

Patching Concrete.—As pavements begin to show signs of deteriorating, due to advancing age, maintenance work and costs naturally increase. In our older roads there was not the uniformity of mix and structure that we are obtaining today; and there never will be a pavement with uniformity of sub-soil or drainage. Spots develop which weaken and fail from the above causes while neighboring sections still appear to be good for some time yet to come. In these cases it is well to proceed with the idea of reconstructing these failed areas, rather than with the idea of maintaining the pavement. Perhaps it does not seem important what the idea is, so long as the pavement is repaired. The difference does lie in the influence our idea can have on how we make these repairs. Reconstruction of the weaker parts of the pavement carries with it the idea that if the failed sections are rebuilt with sufficient added thickness over and above the thickness specified some years past for the original road, and sections are replaced of sufficient area to give the repaired section an independent bearing of its own; then there is reason to expect that the remainder of the pavement, already tested far beyond our wildest dreams in the days when the road was built, will stand yet a reasonable length of time without undue maintenance expense. Going at the same problem with this idea of reconstruction is too apt to result in patches of insufficient depth and area, of careless mix and neglected curing, with the painful results of having to come back later to do that same work over while original parts of the pavement are still giving good service.

In making repairs with concrete on our older pavements, which also are our narrower ones, it is becoming increasingly difficult to handle this work satisfactorily without closing the road. To date, it has been our practice to stock pile aggregate and cement along the road to be repaired. We then send an air-compressor with concrete breaker tools ahead of the mixer. Failed sections of concrete are broken out with the compressed air tools and the broken material hauled away and used for widening narrow fills on some of our earlier construction, for rip-rapping around bridge abutments; or it is given to property owners who desire it, if such disposal cuts the length of haul. The mixer follows closely behind the air hammer operations; it being our plan to keep only about one day's production broken out ahead of the mixer. We charge the mixer skip with shovels from stock piles and place the concrete with concrete buggies. After the patching has been made and finished by hand it is barricaded, and protected at night with kerosene flares. All of these operations confined to one-half of pavements having only a total width of from 16 to 20 ft., with the trucking away of broken concrete and the bringing in of cement and aggregate which this operation involves, added to normal traffic on the road, results in quite a serious traffic problem in some instances. We have considered eliminating some of this confusion by either hauling ready mixed concrete to the job or else, at least, hauling and charging material directly into the mixer from trucks. One or the other of these two schemes will have to be used or, during patching in future on busy thoroughfares, the entire road will have to be closed; not only to safeguard the public and our men, but also in order to secure the maximum in good results in our work.

Surface Treatment for Scaling.—In addition to tarring or asphalting cracks and joints of concrete pavements, and the reconstruction with concrete of such areas as have failed, we have one other problem on concrete pavements which is more and more forcing itself on our attention; namely: scale. Without taking time to enter into a discussion of the cause, the fact remains that we have it. Last summer we took initial steps against this evil by surface treating lightly two roads where scale has been excessive. Using fine slag for cover material we did not get particularly unsightly results and we believe that a light surface treatment will prevent progressive scaling of these areas. Some eastern states, particularly New York, have gone extensively into this work, I understand. Their experiments have varied from a light surface treatment up to the construction of asphalt wearing surfaces. Until the work we have done has been down long enough for us to determine how many months a light treatment will last, I am not prepared to state whether or how scale may most economically be counteracted by the use of bituminous materials, but there has been enough scale on older roads in Michigan to warrant considerable thought; not only on how it may be eradicated, if possible, in the future, but also on what to do with that which we already have.

Checking Overloads.—The real enemies to concrete pavements in this latitude are frost, unfavorable sub-soils and overloads. Frost cannot be controlled. Sub-soils cannot be brought entirely under control. Overloading can be. To some movers of heavy equipment and to some trucking concerns the idea that the tax payers of this state have not gone down into their pockets in a large gesture of benevolence to furnish them with a fine system of paved highways here in Lower Michigan to do with as they please is so revolutionary to their long held conception of just why we did build these pavements; that, in the beginning, control of this evil may seem difficult as an attempt to control the elements; but it can be done.

Any county having a reasonable mileage of state and county roads is justified in employing at least one deputy sheriff to give his full time to checking truck loadings and the movements of overloads. The present law assumes that local law enforcement agencies will attend to this matter. Best results will be obtained, however, by men working directly under the orders of either county road organizations or the state highway department; and the expense is perfectly, justifiably chargeable to road funds.

Truck Weighing.—Weighing deputies will accomplish most good by visiting gravel plants, brick yards, cement plants and other general sources of possible overloads. If these business concerns can be assured that their competitors are also to be weighed with the same scales they will more readily concede that compliance with the law will be a good thing for all concerned.

One man weighing on the roads of a county will not stop all overloads by any means. One man in each county, however, would go far toward reducing the present evil. Relentless warfare should be waged against such haulers as show no signs of staying within legal limits. Weighing should be done, part of the time, at night. There always has been considerable trucking done after dark, and there will be a considerable increase in this amount when it becomes known that you have a man weighing in the day time.

In the spring, when load restrictions are in effect, most certainly every county should have at least one set of scales working night and day, and as many more sets as their road conditions demand and their funds will allow. Every overload apprehended on the highway should be stopped and not allowed to proceed until the cargo has been reduced to legal limits. This should be done in addition to giving the truck driver a ticket ordering him to appear before a justice to answer to a charge of overloading. Unfortunately the present laws governing overloads only permit us to revoke the licenses of drivers in cases of repeated violations. This is in addition to fining the owners of the equipment, of course. Taking up the license plates of offending vehicles would better serve our purpose as the owners are the responsible parties; whereas the truck driver is

merely acting under his employer's orders.

Safety in Maintenance Operations.—More and more we become handicapped in our pavement maintenance operations on heavier travelled roads; if we are to give proper thought to safety, both to the public and to our own men. Any sort of work on such pavements on Saturday afternoon or even entire days preceding holidays has been given up sometime past, except in cases of extreme emergency. At other times, whenever possible, work is confined to one-half of the pavement in case of a two lane traffic road, and to a single lane if on a wider thoroughfare. Thus, in tarring, our men are kept pretty well covered off by the truck and the tar kettles while pouring and covering. In concrete patching this same practice confines our barricades to one lane at a time; and material is stocked and handled, whenever possible, on the side of the road upon which the men are working.

On any pavement carrying sufficient traffic to warrant four lane construction it will be necessary, as a safety measure, to place heavier emphasis on the center line which divided traffic moving in opposite direction than is needed on the quarter lines, which are only divisions of lanes moving in the same direction. With this in mind, we have painted a white stripe down each side of the tarred center stripe, which gives a very striking center division.

Care of Shoulders.—Shoulders along concrete pavements, particularly the narrower ones, will become a troublesome problem as traffic continues to increase. No shoulder material is more pleasing in appearance than good sod. Along some of our concrete roads built at an early date sod had a chance to get well rooted and much of it remains even though traffic punishes it considerably. Certainly we cannot produce a good sod on many roads today where heavy traffic begins as soon as the road is built. In such cases we should consider the construction of a light gravel shoulder; and, on hill slopes where we get continued wash along the edge of the pavement, it is economy to bind the gravel with tar or asphalt. This is also necessary on the inside of curves where traffic will not allow the loose gravel to remain.

Acknowledgment.—The foregoing is a paper presented at the 16th annual Highway Engineering Conference at the University of Michigan.

Motor Fuel Taxes Total $431,636,454 in 1929

THE 48 states and the District of Columbia collected $431,636,454 in taxes on the sale of 13,400,180,062 gal. of motor fuel in 1929, reports received by the Bureau of Public Roads of the U. S. Department of Agriculture show. This includes a 12-month collection in 46 states and the District of Columbia, a 5-month collection in Illinois, and the collections of eight months in New York. Illinois and New York were the last states to adopt this method for part payment of the highway bill. The pioneer states—Oregon, Colorado, North Dakota and New Mexico—led the way in 1919. Now all the others have followed, but the tax did not become effective in New York until May 1 and in Illinois until Aug. 1.

The average fee per gallon was 3.22 ct. as against 3 ct. in 1928. In the course of the year 20 states increased the rate of taxation either 1 or 2 ct. The highest tax per gallon was 6 ct.; the lowest 2 ct. At the close of the year, three states had a 6-ct. tax; eight a 5-ct. tax; 19 a 4-ct. tax; one, Utah, a 3½-ct. tax; 10 a 3-ct. tax; and seven states and the District of Columbia a 2-ct. tax.

In 1929 the rate per gallon was increased 1 ct. in Colorado, Florida, Indiana, Kansas, Minnesota, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, South Carolina, Vermont, Washington and Wyoming; 2-ct. increases became effective in Georgia, Louisiana, Montana, Nebraska, Tennessee and Texas.

Comparison of the total number of vehicles registed in 1929, with the total tax collected and with the taxable gallonage in all states (except New York and Illinois) and in the District of Columbia shows an average tax revenue of $17.72 per vehicle and an average purchase of 532 gal. of gasoline.

After deducting collection costs, the entire net revenue in 34 states was used for construction and maintenance of rural roads. In the other 14 states and the District of Columbia, a total of $24,405,207 was used for other purposes. In three states part of the tax-money helped support public schools. In eight states, a part of the revenue went to cities for repair and improvement of streets, as did the entire collection for the District of Columbia. In six states, small sums were deposited in general funds; in Mississippi, a special, extra tax was collected in two counties for seawall protection of highways; and in New Jersey a small fraction of the receipts was turned over to the Department of Commerce and Navigation.

Of the revenue applied to rural roads, $297,967,756 was used for construction and maintenance of state highways; $85,113,708 for construction and maintenance of local roads, and the remainder, $23,371,785, applied as payments on state and county road bonds.

The following table shows the total motor fuel tax receipts and total number of gallons taxed in the several states:

Total Receipts and Total Number of Gallons Taxed

State	Total tax collections on gasoline and other receipts	Net gallons of gasoline taxed and used by motor vehicles
Alabama	$ 7,105,009	178,162,903
Arizona	2,559,839	63,995,783
Arkansas	6,681,029	133,620,566
California	34,192,087	1,139,736,244
Colorado	5,218,064	141,466,891
Connecticut	4,097,175	202,354,590
Delaware	935,947	31,198,248
Florida	12,231,336	223,373,467
Georgia	10,224,108	219,609,473
Idaho	1,946,359	48,658,984
Illinois	11,659,778	388,659,266
Indiana	15,610,540	410,936,759
Iowa	9,355,785	311,859,516
Kansas	8,171,205	288,716,546
Kentucky	7,742,564	154,717,831
Louisiana	6,978,651	176,645,631
Maine	3,708,682	91,610,422
Maryland	6,297,168	157,429,197
Massachusetts	9,758,816	487,940,778
Michigan	21,312,929	710,300,302
Minnesota	8,892,125	338,631,771
Mississippi	7,176,126	140,902,401
Missouri	7,680,672	384,033,575
Montana	2,802,017	57,514,249
Nebraska	7,799,479	208,869,358
Nevada	652,301	16,307,535
New Hampshire	2,267,052	56,676,294
New Jersey	9,996,104	498,063,808
New Mexico	2,289,767	45,479,332
New York	19,087,392	962,601,285
North Carolina	12,006,384	260,210,528
North Dakota	1,801,102	71,591,708
Ohio	34,082,188	910,154,885
Oklahoma	10,841,609	314,388,292
Oregon	4,542,602	152,090,900
Pennsylvania	35,757,816	1,047,914,175
Rhode Island	1,545,961	77,826,879
South Carolina	6,871,076	118,038,130
South Dakota	3,545,765	88,644,138
Tennessee	9,290,853	194,497,225
Texas	22,317,494	761,421,692
Utah	1,979,610	56,546,967
Vermont	1,703,091	43,990,554
Virginia	9,894,941	197,898,821
Washington	5,943,039	233,333,570
West Virginia	4,873,298	121,654,788
Wisconsin	7,485,039	374,251,957
Wyoming	1,296,299	34,242,816
District of Columbia	1,428,181	71,409,032

Blast-Furnace Waste for Roads in England.—A new process for utilizing slag from the blast furnaces in the Tees district for road-making material has been started by Bolckow, Vaughan & Co., Ltd., of Middlesbrough. For some years past operations have been confined to the huge slag banks in the district for the purpose of obtaining the material, a method which involved considerable expense and the employment of a large number of men. The new system is expected to revolutionize the industry of making material for roads from the waste of the blast furnaces. Instead of taking the slag to the tips, it will be run in its molten state into casting pans near the furnaces and formed into cakes about 15 in. thick. While cooling the slag hardens into a rock-like substance. When cool the cakes are broken up and screened and grated for delivery to the road maker.

Cotton in Road Construction

Fabric Membrane Applied to Improvement of Earth Roads in South Carolina and Texas

By H. S. JOHNSON

The Cotton-Textile Institute, Inc., New Yok, N. Y.

HIGHWAY improvement is the order of the day. On every side the demand for good roads—and for better roads—has attained such proportions that highway engineers, builders and public officials are confronted by the question of how to meet such urgent needs and build for the future. New methods and new technique steadily make their appearance so that the highway engineer is searching for the best and most modern methods of construction.

In this connection there is particular significance in experiments now being made in the use of cotton fabrics in improving country roads by a modification of the bituminous surface treatment of earth roads. The results of these experiments, which have been carried on in South Carolina since 1927 and in Texas since 1929, already have attracted extensive notice in foreign countries as well as in the United States because of the distinct changes in engineering technique which are now indicated.

Applying Covering to Cotton-Fabric-Membrane Road in Gonzales, Tex.

South Carolina and Texas Experiments.—It was quite fitting that experiments with this new use of cotton should be undertaken first in the south, where cotton is important not only as a farm crop but as a manufactured product. In an effort to determine the practical value of cotton in road construction, Charles H. Moorefield, state highway engineer of South Carolina, installed a cotton membrane in a bituminous surface mat constructed on the earth-type surface of country roads which were being improved in Spartanburg and Newberry counties in that state. Directly as a result of tests made since these experiments were started, highway engineers in Texas have undertaken similar work. In the Texas experiments the entire surface of the road was covered with the fabric similar to the first experiment in South Carolina, while in the second experiment in the latter state only the shoulders have received the additional protection of a fabric covering.

Method of Application.—At the present time results of these experiments indicate that rural roads can be improved quickly, economically and satisfactorily by such use of a cotton fabric membrane in combination with light tar and asphaltic oil.

By this method the highway is first subjected to that processing ordinarily employed in bituminous surface treatment of earth-type roads. The surface of the road is first scarified, brought to the desired cross-section and grade and is then opened to traffic to allow it to rebond, the surface of the road being kept smooth by the use of scrapers or drags. The earth comprising this road should consist essentially of small-size gravel with a mixture of sand and clay as a binding material.

After the surface of the road is thoroughly rebonded, it is again closed to traffic and thoroughly swept for the entire width of the treatment with a revolving broom, supplemented with hand brooms, all loose particles being removed.

A prime coat of ¼ gal. per square yard of light tar, of 8 to 13 specific viscosity, is then applied. This light tar should not have more than 2 per cent water content and a softening point of not more than 60 deg. C. or 140 deg. F., with a total bitumen content of 88 to 97 per cent.

After an interval of 24 hours a cotton fabric is spread longitudinally along either the entire surface of the road treatment or the shoulders only. This should be done while the tar is still sticky enough to hold the fabric in place. This cotton fabric weighs 4.61 oz. per yard 36 in. wide and contains 3½ warp threads per inch and 7 filling threads per inch, both yarns 4-ply.

Approximately 0.4 gal. per square yard of asphaltic oil, 150 to 200 penetration at 25 deg. C. (77 deg. F.), is then applied hot (not less than 275 deg. F.) to the fabric and surface. The asphaltic oil must be homogeneous and free from water, and should not foam

Applying Cotton Fabric in Gonzales, Tex.

This South Carolina Road, Constructed with a Cotton-Fabric Membrane, Has Been in Service Three Years

when heated to 175 deg. C. (347 deg. F.). The surface is then immediately covered with about 50 lb. per square yard of coarse sand or coarse sand and fine gravel or finely-crushed limestone or granite. As soon as this covering has been applied the road is ready for traffic.

Specifications.—There are certain requirements in this method of construction that must be met in order to obtain a satisfactorily finished road. All dust, dirt and loose or foreign material must be removed for the full width to be treated by sweeping with a revolving broom or other approved mechanical sweeper, supplemented by hand brooms. Dust or other loose material in depressions or other places not reached by the mechanical sweeper must be swept out with hand brooms. Great care must be taken to clean thoroughly the outer edges of the strip to be treated. Sweeping should continue until all the dust or loose dirt is removed before application of the prime coat of light tar. The tar shall not be heated to a temperature greater than 150 deg. F. and shall be applied at a temperature of not less than 125 deg F. It shall not be applied until the earth-type surface has compacted and bonded under traffic and then only when this surface has been properly swept and is firm, compact and dry.

The asphaltic oil shall not be heated to a temperature greater than 375 deg. F. and shall be applied at a temperature of not less than 275 deg. F. It should not be applied unless the prime coat of light tar is firm and intact and free of any signs of moisture and when the temperature of the air is not less than 50 deg. F. in the shade.

Status and Advantages of Treatment.—When the experimental sections of the state highway in South Carolina thus treated were inspected after the first year it was found that the shoulders of the highway were in excellent condition and showed very little wear. These experimental stretches totaled 1¼ miles in length and the early success of the experiments was responsible for the state highway department's announcement that it would undertake similar improvements on 70 miles of highway during the succeeding two years.

One of the principal advantages of this new method of treatment is the low cost of the installation and maintenance. This is a particularly important factor in states having extensive networks of dirt country roads which for various reasons have not yet been improved.

In addition to the comparative economy of initial construction, further advantages are claimed for this method as follows:

a. Increased supporting strength of surfacing material under outer edge of treatment by preventing rain water running off impervious surface treatment soaking into the surfacing material.

b. Reduced progressive failure of impervious surface treatment by strengthening the treatment's resistance to shear and holding broken pieces of the treatment in place.

c. Tends to delay displacement of small piece of impervious surface treatment on edges of a road where selected earth-type surfacing is of inferior quality or inadequate depth or which for any other reason is not of sufficient strength to support the wheel loads of highway traffic without appreciable deformation and has resulted in cracking in checkerboard design after the treatment has been in place long enough to become brittle. This cracked condition is often referred to as "elephant hide."

d. Retards the forming of corrugations by restraining flow or displacement of materials when too large a proportion of bituminous material has been used in the surface treatment or from traffic continually following one lane.

Cotton is also used extensively in other types of road construction—particularly as a cleavage fabric between the upper and lower courses of concrete highways. In this case the cotton mesh is laid over the base course and the top course is poured upon it. Although pervious to the fine mortar used in the top course the fabric is impervious to the coarse aggregate used in the base and thus provides a cleavage plane so that when repairs or resurfacing may be necessary the top course can be cleft or split off and the road resurfaced without impairing the foundation.

If the final results of service tests now being made with cotton in highway construction support the conclusions already derived this new technique should be of great significance to road builders and the public that is demanding improved means of transportation.

Special Sign Truck.—The New Mexico State Highway Department has had a special sign truck built which has been at work during the past month. Additional warning signs have been erected along U. S. 85 north of Las Cruces. Directional signs and signs at county lines will be erected soon.

Close-Up at Edge of Membrane on a South Carolina Road

Prequalification of Highway Bidders

Prequalification Operates as Advantageously to the Public as It Does to the Contractor

By CLIFFORD SHOEMAKER

District Engineer, U. S. Bureau of Public Roads, Omaha, Neb.

DURING the last decade engineering as well as contracting have undergone many changes, especially for the better. In general engineers have become broader of mind; cooperation rather than mere guardians of specifications being their desire. It is almost universally recognized today that the constructor is not only entitled to a legitimate profit for his work but that the making of the profit really brings economy and satisfaction to those who pay for the improvement.

During this decade particular interest has been shown in the development of equipment, machines, and methods necessary and sufficient for the economical construction of an improvement. Practically all of the constructor's equipment is now standarized and he is using every effort to prevent accidents, eliminate losses through proper control of his accounting, as well as his constructing, and the engineer is cooperating in an effort to develop uniform contracts and to discourage some of the unfortunate practices of corporate surety bonding.

In this last decade there has been introduced a practice commonly known as prequalification of bidders. It is the determination in advance of bidding of the fitness of a number of constructors who will probably bid on certain public work. With bona fide prequalification this group of qualified bidders is established in advance of the opening of bids and the opening of bids merely determines from this qualified group which one is the low bidder.

On account of the great increase in the amount of highway work which has grown up during the last 15 years there have also been developed a great number of contracting organizations. It is due to the ambition on the part of those who are like the fellow who approached a contractor and said: "I have driven a truck for a general store for 5 years. Now I desire to become a contractor. Please help me." Had it stopped at that point, all would have been well but too many have attempted to build roads with no further experience than truck driving.

Capital Equipment and Experience.—It is almost elementary to say that before one should undertake the building of a large project he should have sufficient capital or credit to properly finance operations under most adverse circumstances. He should have available adequate equipment to do the work within the time prescribed. Last, but not least, he should have the background of experience to assure the contracting officer that the work will be properly performed in accordance with the agreement and to the satisfaction of all concerned.

The measure of these different qualities prior to the submission of a bid or to the entering into a contract might properly be termed a prequalification of the bidder. That is he must show that he is qualified previous to entering into the contract for the performance of the work. A survey of practices discloses the examination of qualifications at three different stages: (1) which has been in general use for many years is that of finding out if the bidder is qualified after he has submitted his bid and prior to entering into contract; (2) through the submission of certain forms upon which the bidder makes declarations at the time of filing the bid, and (3) that of determining the qualification of the bidder prior to his submitting the bid. In some instances they refuse to permit an unqualified bidder even to have the plans, specifications or proposal forms. The last practice may eventually become general and give the best results but it does not seem to be consonant with our democratic institutions nor in accord with our liberty-loving American public. We are all familiar with our criminal code which is founded on the basic principle that everyone is innocent until conclusively proven guilty. Those anxious to get into the contracting profession often stand on a similar footing in that they claim they are qualified until they are conclusively proven disqualified.

What the First Contract Proves.—Ordinarily the first contract they get proves to their own satisfaction that they are not qualified but unfortunately they are not the only ones that suffer financially. In the construction of the highways of the United States hundreds of contractors have defaulted, losing their money and what they could borrow from others, delaying the completion of the projects and in that manner saddling a greater burden upon the traveling public. One of the minor details of prequalifications is and has been the real stumbling block preventing general adoption of the practice. That minor detail is the mere statement in advance as to what qualifications a bidder must have. Some method must be devised to properly set up the minimum requirements which a bidder must meet in order to be permitted to submit a proposal on a project of a certain magnitude. It is obvious that a contractor who has been very successful in placing concrete sidewalks and who might have an adequate amount of equipment for that class of work would not be qualified to undertake the construction of ten miles of the standard type of concrete highway pavement.

The Minimum Requirements.—It is my opinion that as much research study should be devoted to the proper minimum requirements to permit a bidder to submit a proposal on various projects of different magnitude as there is to the general subject of prequalification. When that detail is satisfactorily settled the general subject of prequalification will be more favorably received by both the constructors and the contracting officers. I submit that those who determine such policies are accustomed to handle things in the concrete rather than in the abstract, in the particular rather than the general, and when the formula is developed so that they can apply it to their work, they will appreciate the solution, and, in most cases, will adopt the method.

The United States Bureau of Public Roads in work which they handled directly, that is in the construction of highway projects, in the national forests, and in the national parks have been using a scheme of prequalification for about three years.

Wisconsin has practiced prequalification since 1925 under a ruling of the Highway Commission. Iowa has used a similar prequalification since 1927. California began the prequalification of bidders under a State law effective August 15, 1929.

The Missouri Requirements.—Missouri has recently modified her contracts and is now requiring:

"To be eligible on any contract the person desiring to submit a bid must meet certain definite standards which will be formulated and approved by the State Highway Commission. These standards will vary according to the type of work to be done, but they shall be uniform and applicable alike to all persons desiring to bid on any particular job. These standards shall specify the financial resources, the kind and amount of equipment and the experience, which, in the opinion of the Commission, must be possessed in order that a contractor be eligible to submit a bid on the particular work in question. Any contractor desiring to submit a bid upon any particular job, and who can show that he has met the standards imposed upon contractors bidding upon this particular job, may submit a bid and shall have his bid considered. A copy of the standards which must be met in order to qualify one for bidding on a particular job may

be obtained by applying to the Chief Engineer. Nothing contained in this section of the contract shall be construed as depriving the commission of its discretion in the matter of deciding to whom it will award any particular contract.

"In addition to the above requirements, each proposal shall be accompanied by an equipment questionnaire, submitted on forms provided by the Commission, and which clearly states the equipment available to the bidder for use upon the particular work involved in the proposal. Any proposal not accompanied by the equipment questionnaire may be rejected as irregular."

How Over-Extension Is Prevented.—The questionnaire forms mentioned above were developed in conferences by representatives of the Associated General Contractors of America and other interested parties as it should have been. The Bureau of Public Roads considers the method very successful as it tends to eliminate even from the bidding those pseudo constructors who are neither equipped nor financed to undertake such a project. In the handling of the method by the Bureau, even though a constructor may be qualified to bid upon a certain project, should he be awarded that project, he might not be qualified to submit a bid on another until his work was well advanced on that particular one. From this you can see that even the stronger firms are not permitted to over-extend themselves. From the point of view of accomplishing the construction, it is just as serious to have a well-established, thoroughly-experienced and financially-strong firm over extend their ability as it is to award the contract to a concern utterly incapable of handling it. The final result is the same from the point of view of the traveling public who ultimately pay the bill.

In the determination of the qualification of a bidder it is necessary to study individual cases thoroughly in order to avoid being arbitrary. Qualifications must be considered in their entirety at the present time and there can be no set rule or formula for rating the different elements which are required. Character, experience, organization, equipment and finances are all important. The financial condition is determined by the difference between quick assets and liabilities. Unsuitable equipment is a liability. A good past record of performance is a wonderful asset. The constructor should be assured from the first that his statements will be kept in strict confidence and the betrayal of this confidence on the part of the contracting officer should result in his immediate dismissal from service. The contracting officer should also show good judgment in establishing the date of completion, and the constructor's bid should duly reflect the decision which he made. A short time for completion on certain projects might result in a very extraordinary cost for that piece of work. The constructor should bid with the idea that the work must be completed on time. The contracting officer should live up to his responsibility to the constructor. There should be a consistent effort and strict discipline for the prompt payment of estimates as they become due.

The Bureau of Public Roads has recently decided that unless cooperative funds are immediately available for prompt payment of obligations incurred in the highway work, no agreements will be entered into.

The constructor will be required to complete the work within a specified time and by the same token he has a right to assume that when the work is accepted, prompt payments will be made.

Prequalification of bidders has, and will operate for the constructor's benefit. However, highway constructors are indispensable to the future of the highway program and, unless proper regulations can be enforced, at times there will be delays which will deny the traffic use of the new project or oblige it to operate over troublesome detours for too long periods.

The prequalification of bidders will operate as advantageously to the public, if not more so than to the constructor whom it is believed to benefit the most.

Acknowledgment.—The foregoing is a paper presented Feb. 25 at the Wichita Road Show and School.

Motor Registrations Pass 25,000,000 Mark

Reports from state registration authorities to the Bureau of Public Roads, U. S. Department of Agriculture, show a total of 26,501,443 motor vehicles registered in 1929. The states and the District of Columbia collected in license fees, registration fees, permit fees, fines, etc., the sum of $347,843,543.

The registration figure includes passenger automobiles, taxis, busses, motor trucks, road tractors and trailers, and motorcycles, and represents an increase of 2,008,319, or 8 per cent over the 1928 figure. The total fees collected represent an increase of $25,213,518 over the 1928 figure. After deducting $24,505,737 for collection and miscellaneous purposes, the balance of $323,337,806 was applied to highway purposes: $223,292,969 to state funds, $66,861,364 to local funds, and $33,183,473 to state and county bond funds.

The ten states having highest registration figures are: New York, 2,263,259; California, 1,974,341; Ohio, 1,766,614; Pennsylvania, 1,733,283; Illinois, 1,615,088; Michigan, 1,395,102; Texas, 1,348,107; Indiana, 866,715; New Jersey, 832,332; and Massachusetts, 817,704.

In percentage gain, the District of Columbia and New Mexico each show 19 per cent. Nevada reports a gain of 16 per cent, Arizona 15 per cent, and Utah 14 per cent. Four states, Georgia, Maryland, Massachusetts and Tennessee, each show a gain of 12 per cent, and three states, Michigan, Montana and Texas, each report an increase of 11 per cent. California, Idaho, Kentucky, New Jersey and Washington each show a gain of 9 per cent.

The registration totals and fees collected for all states are as follows:

Motor Vehicle Registration and Fees

State	Motor Vehicles Registered	Registration Fees
Alabama	285,533	$ 3,736,380
Arizona	109,013	748,565
Arkansas	233,128	4,212,161
California	1,974,341	10,489,068
Colorado	303,489	1,835,386
Connecticut	328,063	7,992,755
Delaware	54,960	1,023,440
Florida	345,977	4,959,129
Georgia	358,905	4,568,209
Idaho	118,074	1,787,467
Illinois	1,615,088	17,087,209
Indiana	866,715	6,253,424
Iowa	784,450	11,919,350
Kansas	581,223	5,697,306
Kentucky	332,848	5,381,302
Louisiana	280,868	4,523,634
Maine	184,506	3,030,128
Maryland	319,873	3,295,314
Massachusetts	817,704	7,117,725
Michigan	1,395,102	23,212,316
Minnesota	730,399	10,846,826
Mississippi	250,011	2,963,381
Missouri	756,680	9,690,727
Montana	140,387	1,549,487
Nebraska	418,226	4,289,969
Nevada	31,915	296,881
New Hampshire	108,880	2,248,213
New Jersey	832,332	14,803,016
New Mexico	78,374	756,763
New York	2,263,259	38,293,313
North Carolina	483,602	7,045,116
North Dakota	188,046	1,989,475
Ohio	1,766,614	12,860,453
Oklahoma	570,791	6,964,360
Oregon	269,007	7,644,226
Pennsylvania	1,733,283	29,264,695
Rhode Island	134,009	2,403,809
South Carolina	231,274	2,674,379
South Dakota	204,199	3,150,657
Tennessee	362,431	4,288,420
Texas	1,348,107	20,418,696
Utah	112,661	838,300
Vermont	93,030	2,339,782
Virginia	387,205	6,145,296
Washington	442,341	7,547,382
West Virginia	268,888	4,565,836
Wisconsin	793,502	11,780,703
Wyoming	60,680	647,200
District of Columbia	151,450	665,914

No Change in Simplified Practice Recommendation on Vitrified Paving Brick

The Permanent Committee on the simplification of varieties and sizes of vitrified paving brick, at a meeting held in the Hotel Washington, Washington, D. C., on April 1, 1930, unanimously reaffirmed Simplified Practice Recommendation No. 1-29—Vitrified Paving Brick, without change, for another year.

A survey, made by the National Paving Brick Manufacturers' Association, was used as a basis for discussion. This survey showed that the six recognized sizes of paving brick, as adopted last year, presented 87 per cent of the total shipments for 1929. No other sizes showed sufficient increase in production to warrant inclusion in the recognized list.

ROADS and STREETS

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$750,000,000 Appropriated for Federal-Aid Roads

Twenty-four years ago the editor was the engineer member of a small group of men who went to Washington, D. C., to urge congress to appropriate money for federal aid in road building. Small as the sum was that we asked congress to appropriate, we failed to secure approval of it by the "house committee," but we did secure the approval of the "senate committee." With that opening wedge driven home, efforts were continued until a small appropriation was finally secured.

Two main arguments were raised against such federal aid: (1) that it was paternalistic in nature, because highways were local institutions; (2) that "pork barrel" methods would result in unwise and extravagant expenditure of federal funds. To the second objection we replied that by compelling each state to match dollar for dollar with Uncle Sam in road building, no state would run wild in its requests for federal aid. To the first objection we replied that roads were not purely local utilities, and that no county had ever secured a satisfactory system of highways until it ceased to regard them as purely local in their service. The Romans were the first to abandon the conception that roads are of purely local concern. Inspired by their example other nations in Europe eventually adopted a similar conception, and not till they did was any great progress in road building achieved. We were met by the counter argument that many of our states are as large as European nations, and that our states were able to finance all road improvement not purely local in its nature. This was the only sound argument that was ever raised against federal aid. Our reply to it was something like this: Very few of our states had at that time adopted a state-aid policy in road building, in spite of the fact that it had been very satisfactory in the states that had adopted it. What was sorely needed was some stimulus that would spur all the states to follow the lead of the few. The federal government could provide that stimulus by offering to pay half the cost of certain state roads. An Office of Public Roads had been brought into existence in the Department of Agriculture for the express purpose of educating and guiding road builders throughout America, but it was handicapped for lack of money. Moreover, it should have the power to drive home its teachings by object lessons on a large scale. Finally, the federal government not only used the roads in its rural delivery of the mails, but for military purposes. In war time, the military use of roads is usually so important that this consideration alone would warrant very large federal appropriations for road improvement.

All these arguments now sound as self-evident as axioms, but they were not so axiomatic a generation ago, as was proved not only by our initial failure to secure federal aid, but by the fact that not a single editor of an engineering or construction magazine, except the writer, wrote a single editorial article espousing the cause of federal aid. On the contrary, several of them openly opposed it, and the leading civil engineering magazine even opposed state aid in road building.

Well, that is past, but we may be pardoned, we hope, for writing of past efforts when we read in the daily papers of April 5, 1930, the following:

When President Hoover at 1 o'clock today signed the Phipps-Dowell highway bill he authorized the greatest federal contribution to highways the nation ever made. The bill authorizes from the federal treasury for each of the fiscal years of 1931, 1932 and 1933 $125,000,000, which must be matched by the states dollar for dollar, and increases the federal contributions for highways $50,000,000 a year.

In 1917, when the first federal aid for highways was enacted by congress, the extent of federal aid offered the states annually was only $5,000,000. Federal and state expenditures for highways under the bill signed today for the next three fiscal years will total more than $750,000,000.

The Crying Need of More "Intelligent Ignorance"

Trying to rate the mental powers of different men is like trying to determine which is the most important organ—the lungs, the liver or the heart. Yet a certain type of mind delights in selecting "the ten greatest living scientists" or "the seven greatest men of all history." After recently making such an attempt, a scientific writer says: "Probably there will be those to say that ignorance is deplorably evident in my

selections. Maybe so. It would take a truly great man to select the world's greatest, and a great man would have too much sense to try." Let us hope so, but let us be not too hopeful. Even great men are prone to believe that they can weigh the mental capacities of their contemporaries, as witness many a biography that tells of such attempts.

Just after some authority has predicted that the next great discovery will be made by one of a certain few great scientists, behold it is made by an entirely unknown man, often by a person with but little previous experience in the field to which his discovery relates.

C. F. Kettering, head of the General Motors Research Corporation, recently said: "When we want a man to work on a (research) problem we ask him if he knows anything about it. If he can truthfully answer that he knows nothing about it, we hire him. If he thinks he knows something about it, he will get in here and the first thing you know he will be telling others what he knows, and after a while they will all know that the problem cannot be solved. An expert is a man who knows all about a problem. That's why he's no use to us. We have to have men who not only don't know about it, but know they don't. We have to have what I call intelligent ignorance."

All of which will be startling to most readers. Yet it is almost exactly what Ford said several years ago in "My Life and Work," and it is what many another inventor has said. Are they all wrong? Or are the non-inventors and the non-discoverers right in thinking that originality in any field is to be looked for mainly in those who have spent many years working in that field?

Turning to the history of science (which, by the way few ever turn to) we find remarkable confirmation of the Kettering and Ford generalizations. Scientific history is literally crowded full of names of men who were not experts in the fields where their greatest discoveries were made. After a mathematician, like Isaac Newton, for example, has made a great astronomical discovery, the astronomers (rather tardily, to be sure) not only welcome him but make him a member of their astronomical societies, and thus he comes to be regarded by the public as an astronomer—as an astral expert. But watch such a discoverer, and note how often he turns to some other field of science, such as physics, and discovers other laws. Newton the star expert was Newton the sound expert, Newton the light expert, and Newton the mathematical expert. He made himself expert in whatever he studied, not in the sense of absorbing all that had been written on the subject of which it formed a part, but in the sense of first absorbing what was known about the particular problem that he attacked and then in learning more about that problem than any predecessor had ever known. If Newton is to be called an expert in the common sense of that term, he must be called, first, a mathematical expert, and, second, a research expert.

In selecting a jury for a criminal case, lawyers see to it that any one who has formed an opinion on the case shall not become a juryman. They seek unbiased minds. Evidently Kettering has found it equally desirable to secure unbiased minds to judge the merit of any new theory, and to do so by eliminating all experts except research experts. Since he employs both pure scientists and engineers, it is clear that he aims to secure not perfect ignorance on his "juries," but trained men who are intelligently ignorant. Obviously a man ignorant of mathematics will be greatly handicapped in trying to solve a problem in mathematical physics. But don't infer that such a man will be utterly useless. There was Faraday, for example, who was so ignorant of mathematics that in all his writings we recall not a single algebraic equation. Yet he framed a conception about ethereal undulations upon which Maxwell built his marvelous quantitative theory of ethereal waves, which Hertz later verified by producing the long waves that are today the foundation of a great business—the radio industry. So you see that even mathematically ignorant Faraday made a suggestion that a great mathematical genius seized and made so quantitatively definite that a laboratory experimentist was able to give it physical existence.

One of the objects of modern research laboratories is to bring a Faraday, a Maxwell, a Hertz, and a Marconi, and a DeForest together, there to perfect almost at one stroke a theory and a device that otherwise would remain undiscovered and uninvented for a generation or longer.

When a new scientific theory is first submitted, editors (scientific as well as otherwise) often ask some well known expert to advise them as to its probable truth. As a rule the answer is that the new theory is either too fantastical or too improbable to merit publication; for, as Kettering says, experts always know that the problem can't be solved that way. Yet listen to what a recent Nobel prize winner, Richardson, said years ago ("Electron Theory of Matter," p. 280): "Fitzgerald suggested that the null effect in the Michelson and Morley experiment was due to a change in the dimensions of the apparatus, just sufficient to counterbalance the expected effect (as to the velocity of light). * * * This hypothesis seems a wild speculation at first sight, but it appears, on further inquiry, that it is rather what might be expected to occur if matter is made up of electrons." And he goes on to tell how Lorentz, adopting Fitzgerald's "wild speculation," deduced a law that Einstein subsequently made famous, namely a law that shows how bodies shorten as their velocity increases, being squeezed to no length at the velocity of light. So the most marvelous development in mathematical physics that has occurred since Thomson discovered the electron about 30 years ago, resulted directly from a "wild speculation." Can't you picture the experts laughing Fitzgerald to scorn, particularly when he was unable to prove his hypothesis to be true? Yes, Kettering is right. Intelligent ignorance is a great desideratum, and, let us add ignorant intelligence is the bane of progress.

H. P. Gillette

Reviews of Recent Books

"Construction of Roads and Pavements," by Prof. T. R. Agg, Highway Engineer; Professor of Highway Engineering, Iowa State College, Ames, Iowa. Fourth Edition; 511 pages, 5¾ in. by 9 in., hard binding in cloth. McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York, publishers. Price, $4.00.

This book, through its various editions, is a text book for a highway engineering course for students of civil engineering that has been carefully revised and the contained material weighed for its fundamental value before being included. Prof. Agg has had a wide experience in highway work and is an authority on highway problems. His research work on the economics involved in highway construction, engineering and operation has given the book a progressive feature that will become of more importance as time goes on.

Students of civil engineering really need a fairly good idea of the systems of management of highway systems. As motor freight interurban transport develops these studies will serve as excellent background for the coordinated solution of transportation. Management, design, construction and maintenance are all excellently treated in this presentation of fundamental principles.

Numerous problems have been included in this edition. It is through solution of these problems applied to local conditions that students benefit materially. In fact, the principle involved can not be fully comprehended until it is actually applied to a local condition where all attendant conditions are well understood.

"Roadside Development," by J. M. Bennett, Superintendent of Parks and Forestry, Wayne County, Mich. First edition; 265 pages, 5¾ in. by 7¾ in., hard binding in cloth. The MacMillan Company, New York City, publishers. Price, $5.00.

"Roadside Development" is a manual of procedure on the design, construction, and maintenance of roadsides. It was compiled from the author's experience of more than ten years with one of the outstanding road development programs in this country. It includes not only the landscaping, planting, and maintenance of roadsides, but the planning of road widths and grades, draining, bridges, lighting, marking, and location of utilities.

It will be an invaluable work book to public officials responsible for highway work, to municipal foresters, departments of public works and city managers; to public utility companies, park commissioners and superintendents, and to landscape architects, subdividers, and land developers. The book will also be useful to students of highway engineering and municipal forestry and will be of interest to chambers of commerce, automobile clubs, and other organizations and individuals interested in our highways.

Since his college days Mr. Bennett has been engaged in forestry, nursery, landscape and road construction. He studied at Texas A. and M. college and Yale, and received the degree of bachelor of science in forestry from Michigan State College in 1919. The next three years he spent in surveying, designing, and building roads and bridges for the Michigan State Highway Department, and in 1922 began the work of roadside development for the Wayne County Board of Road Commissioners in their world-famous parkway program. During the past three years he has studied the road improvements and public parks of nearly every state.

"American Airport Designs," by Taylor, Rogers and Bliss, Inc., for Lehigh Portland Cement Company, analysis of designs by Archibald Black. 96 pages, 9 in. by 12 in., 73 full page plates, paper cover binding. Taylor, Rogers and Bliss., Inc., 40 East 49th St., New York, N. Y., publishers. Price, $3.00.

This book contains the best designs submitted in the recent Lehigh Airports Competition, which was sponsored by the Lehigh Portland Cement Company as a contribution to the advancement of civil aeronautics. While none of the 257 sets of plans entered in the contest may be considered ideal and ready for direct application to specific airport projects, the 73 plates in this book contain literally hundreds of ideas from which to choose those adaptable to modern airports whether modest or elaborate in their size and appointments. The book is full of inspiration to students, designers and airport interests. There is a comprehensive analysis of the designs by Archibald Black to assist in the interpretation and study of the 44 airport plans.

The introduction by Colonel Clarence M. Young, Assistant Secretary of Commerce for Aeronautics, paints a graphic word picture of the need for adequate facilities at modern airports, and concludes with the statement, "Because of the widespread interest being shown in the subject of airport design by architects, engineers and municipal officials, I feel that the publication of constructive suggestions will prove of material aid in developing the nation's airports; and hence in accelerating the growth of America's air commerce."

"American Civil Engineer's Handbook," by Thaddeus Merriman, editor-in-chief, and Thos. H. Wiggin, associate editor-in-chief. Fifth edition, 2,263 pages, 4½ in. by 7 in., semi-flexible binding, gilded edges. John Wiley & Sons, Inc., New York, N. Y., publishers. Price, $8.00.

This edition closely follows the plan and the scope of the first four editions of which the late Mansfield Merriman was editor-in-chief. The first eleven sections present general principles and materials, the second eleven sections treat of principles, design and applications in the several fields comprised under civil engineering.

General Table of Contents

Section 1—Mathematical Tables by the late Mansfield Merriman.

Section 2—Mathematics and Mechanics by Edward R. Maurer.

Section 3—Chemistry, Physics, Meteorology, Weights and Measures. Originally written by Louis A. Fischer.

Section 4—Steam Engineering by George A. Goodenough.

Section 5—Electrical Engineering by F. Malcolm Farmer.

Section 6—Surveying, Geodesy, Railroad Location by Charles B. Breed.

Section 7—Materials of Construction by Herbert F. Moore.

Section 8—Foundations and Earthwork by Walter J. Douglas.

Section 9—Timber Structures by Walter J. Douglas.

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Section 15—Dams, Aqueducts, Canals, Shafts, Tunnels by Silas H. Woodard.

Section 16—Irrigation and Drainage by Horace W. King.

Section 17—Sewerage and Sewage Disposal by Metcalf & Eddy.

Section 18—Refuse Collection and Disposal by Metcalf & Eddy.

Section 19—Harbor and River Works by Rear Admiral Frederic R. Harris (Retired).

Section 20—Highway Engineering by John S. Crandell.

Section 21—Steam Railroads by Fred Asa Barnes.

Section 22—Electric Railroads by William A. Delmar and Charles J. McCarthy.

"Practical Mechanics and Strength of Materials," by Charles Wilbur Leigh, Professor of Analytical Mechanics at Armour Institute of Technology, and John Frederic Mangold, Associate Professor of Mechanics at Armour Institute of Technology. Second edition, 420 pages, 4¾ in. by 7½ in., cloth hard cover binding. McGraw-Hill Book Co., Inc., New York City, publishers. Price, $2.75.

In this volume the usually dry subject of mechanics is presented in such a way as to be easily grasped. This commendatory feature speaks well for any book. The applications of pure mechanics and statistics to typical, practical cases are what helps to make the theories understandable. Throughout the book both graphic and mathematical analyses are made. Many problems are included. The application of calculus for the derivation of formulas is conspicuous by its absence. All formulas are devised that are used and the fundamental conceptions underlying each is explained thoroughly. The text is a good book for vocational classes and home study.

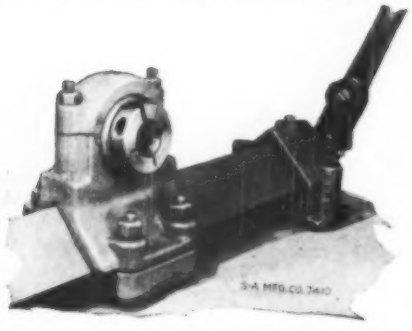
New Equipment and Materials

Recent Developments in Machines, Tools and Materials in the Road and Street Field

New Stephens-Adamson Conveyor Bearing

In announcing a new roller-bearing belt-conveyor take-up bearing, the Stephens - Adamson Mfg. Co., of Aurora, Ill., calls attention to some interesting figures in regard to belt tension and stretch, in belt-conveyor design.

The ordinary belt conveyor consists of a wide endless belt, the upper surface of which carries the load and is



Stephens-Adamson Belt-Conveyor Take-Up Bearing

supported by idlers spaced every 4 or 5 ft. The belt is usually driven by the head pulley and a certain amount of tension must be maintained to give the required traction to the drive pulley. Although conveyor belts are carefully stretched when made, there is a continual stretching or lengthening as the conveyor is used. This does not amount to a great deal, but it is enough to necessitate a take-up pulley to eliminate the slack and maintain a fairly uniform belt tension.

The maximum tension advisable varies with the width of belt, the number of plies and the weight of the duck used to reinforce the belt. As an example, the maximum tension for a 42-in. conveyor belt of 8-ply, 32-oz. duck is approximately 9,072 lb., as compared with 1,152 lb. for a 12-in. belt of 4-ply, 28-oz. duck. In the normal 42-in. belt conveyor this tension of 9,072 lb. is the belt pull at the driving pulley. On the slack or tail end of the conveyor, the tension will have decreased to about 3,000 lb. This means a total pull of close to 6,000 lb. on the take-up pulley with a load of 3,000 lb. on each take-up bearing.

These take-ups are of two general types: the automatic or gravity take-up pulley for long and heavy-duty conveyors and the screw type for shorter belts. The screw take-up bearing consists of a bearing which can be pulled backward on its base as the belt stretches and is generally satisfactory for conveyors up to 200 ft. in length.

These bearings range in size to suit the pulley shaft and in maximum bearing travel to suit the length of the conveyor. As it is considered good conveyor design to provide a take-up travel of about 2 per cent of the conveyor length, a 12-in. adjustment would be suitable for conveyors up to 50 ft. in length, while a 54-in. take-up bearing should be adequate for most belt conveyors up to 225 ft. long.

The new Stephens-Adamson No. 9 take-up bearing consists of a structural steel angle, upon which slides a Timken bearing in a special self-aligning housing. The bearing is moved backward or forward by a screw, protected by the steel angle, and is operated by a ratchet lever designed for use in cramped quarters.

The take-up is furnished for shafts from 1 15/16 up to 4 15/16 in. in diameter and in sizes with a maximum shaft travel of 24 to 54 in. The inner race is fitted with an adapter which receives the shaft without turning or shouldering.

New Maintainer Announced by Adams

J. D. Adams Co., Indianapolis, Ind., manufacturers of adjustable leaning-wheel graders and other road equipment, have announced a new multiple-blade maintainer known as the Adams one-man road maintainer No. 61, which can be hitched to any tractor.

The company states that this is a greatly improved model of their one-man road maintainer No. 6, the principal difference being in the control mechanism. The No. 61 maintainer is a single-control machine and one hand wheel now accomplishes the work formerly done by three. One man taking his normal position on the tractor has quick and easy control of both tractor and maintainer, and heavy lift springs make the raising of the blades an easy operation.

The hand-wheel control, immediately back of the tractor seat, handles all blade adjustments through a simple set of three transmission gears. The control shaft with operating gear is readily shifted to any one of three working positions: pulled into the forward position, the control raises and lowers the front end of the blade structure; in the rear position it raises and lowers the rear end of the machine through the crank-type axle; in the middle position, the one control handles all blades at the same time.

The blade structure consists of 7 blades totaling 40 ft. in length which work the road surface four times in one trip and which are rigidly mounted to a heavy I-beam frame. The blades cut all in one plane, leveling off the high spots and filling in the depressions. Smooth, steady cutting is insured by the 3,850 lb. of effective cutting weight which is claimed to be more than is found in any similar machine.

This maintainer comes equipped with or without front truck, and an independently operated scarifier for loosening up the hard high spots can be had as optional equipment. The normal cutting width of the maintainer is 9 ft., but blade extensions may be added to either side, increasing the cutting width to 12 ft.

New Explosive Developed by Hercules

A new type of explosive now being marketed under the name of Gelamite is announced by officials of the Hercules Powder Co. The new development represents the first successful production of an explosive which will do work ordinarily requiring gelatin dynamite at a considerable reduction in blasting costs.

The result of extensive experimental work in the Hercules laboratories, Gelamite was first placed on the market in small quantities late last year. Field tests were so successful, state Hercules officials, that a large demand for the new explosive arose.

The new explosive combines the safety and economy features of the high-ammonia-content dynamites with the more water-resistant characteristics of gelatin, at the same time being semi-plastic and easy to handle. It is adaptable to either open or underground shooting.

Calculated to serve as an all-around useful explosive which will greatly reduce blasting costs, the new gelamites are being produced in three strengths, successfully replacing the old style gelatins and extra gelatins of 30 to 60 per cent strengths.

New Adams No. 61 Multiple-Blade Maintainer

Electrically Operated Portable Adding Machine

The adaptation of electricity to the Burroughs portable adding machine, without increasing its size or sacrificing compactness or portability, is announced by the Burroughs Adding Machine Co., Detroit, Mich.

The machine's original proportions are maintained as the motor is built into the mechanism without enlargement of the case. The motor will operate from any electric outlet, on direct or alternating current, on any voltage and range of cycles.

The new machine does much of the work automatically and naturally is considerably faster than the hand-operated machine. A simple operating bar, which operates at a touch of the finger, takes the place of the adding machine handle. The machine itself weighs about 25 lb., can easily be carried from place to place and may be safely used on the slidng shelf of a desk. It is being produced in styles and capacities for various uses, as is the hand-operated portable which is being continued. More than 225,000 of the latter have been placed in customers' hands since it was brought out only four years ago.

The electric portable is expected to open new fields for adding machines for desk and general office use where fast, light machines are desired but have not been available, and in opeartions where the hand-operated machine has been found efficient but where the greater speed and ease of electricity are preferred.

Adding electricity to the portable machine gives it much of the operating effiicency and calculating range of the larger electrically-operated Burroughs units. Sub-totals and totals are taken simply by pressing the desired keys. It is not even necessary to press the operating bar. Electric consumption is minimized as the motor operates and current is used only when the motor bar is depressed.

Burroughs Electric Portable Adding Machine

New Gasoline Locomotive

The Midwest Locomotive Works, Hamilton, O., has recently put a new line of gasoline engine driven haulage locomotives into production. The line,

New Midwest Locomotive

when completed, will include eleven individual ratings, namely, 4, 5, 6, 7, 8, 9, 10, 12, 16, 20 and 25-ton respectively.

The main features of design and construction are uniform for the whole line, allowing of course for variations in the size and weights of the parts. They are of the single truck, outside frame type, the patented one-piece frame being made of semi-steel casting.

The wheels are fixed to the axles. The journals as used are equipped with Timken bearings. The trucks can be arranged for the various track gauges. The weight of the body and frame is carried by heavy semi-elliptical springs which are equalized to cushion the shocks when operating over rough trackage, passing cross-overs, etc. The service brakes are manually or air operated by levers in the cab.

Two makes of engines are used to power the locomotives, those up to and including 12 tons being equipped with Hercules engines. The 16, 20 and 25-ton locomotives are powered by Climax engines. The drive is through a transmission, giving four speeds forward and four speeds in reverse through clutches and ring gears which drive the sprockets. The drive sprockets are connected by a chain to another sprocket keyed to the rear axle of the truck. The front axle is driven by a chain from the rear axle on sizes 4 to 16-ton inclusive. The 20 and 25-ton models are side rod driven. All of the shafts in the transmission are mounted in Timken bearings. The reduction from engine speed accomplished by this arrangement gives the locomotive a minimum speed of about 3 m.p.h. and a maximum speed of about 12 m.p.h. in high gear. The driving and transmission equipment has been so mounted as to give the locomotive a high adhesive factor.

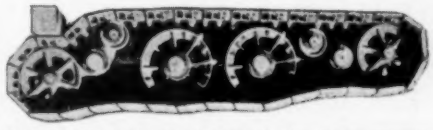
New "64" and "68" Tread Center Drive Crawler

New improved center drive crawlers are announced by The Thew Shovel Company, Lorain, O., for their line of product, the ¾-yd. Lorain-45, 1-yd. Lorain-55 and 1¼-yd. Lorain-75.

The most radical development is represented by the new "64" and "68" tread crawlers. The numerical designation of the crawlers comes from the number of treads in the self-laying tracks. These crawler mountings are available for the Lorain-45, 55 and 75 cranes, clams, drags and backdiggers and offer a modern development in crawler design and operation.

Basically they are the standard "52" and "56" tread crawlers—plus. Instead of the standard single end rollers, equalizer rocker arms, carrying both a large end roller and a small intermediate load-carrying roller, are mounted on the end axles. This placed the large end rollers in advance of the end axle and increases the overall length from 12 per cent to 29 per cent on the various units. The resulting greater supporting area also gives reductions of ground pressures that average from 15 per cent to 25 per cent.

In addition to the materially reduced ground pressures, the action of the equalizer rocker arm is such that the tendency to "dig-in" is eliminated. Any tipping load thrown onto the end axle is transmitted down through the rocker



New Center-Drive Crawler of the Thew Shovel Co.

arm and its two rollers and is distributed by them over an increased area of several treads. This effects uniform lowered ground pressures and eliminates the concentrated pressures that cause digging-in at the ends.

The distribution of the end axle load to its rollers is such that the smaller or rear roller carries the greatest load, the effect on the front end roller being to climb or nose-out of soft materials.

The equalizer rocker arm action in this respect is well illustrated by the traveling action of the crawler. The up-and-down action of the equalizer rocker arm (prevented from reversing by an automatic stop) enables the crawler tread to self-adjust itself to the contour of the terrain without "bridging" across depressions, etc.

With the equalizer rocker arms at the ends the propulsion of the unit must come from the center, thus all the crawler units are propelled by the patented Thew center drive.

When the equalizer rocker arms are replaced with standard single end rollers, "52" or "56" tread crawlers for the Lorain-45, 55 and 75 shovels, cranes, clams, drags and backdiggers result.

For shovel use when it is desirable to keep the shorter standard end of the crawler faced into the bank, equalizer rocker arms may be added at the rear of the crawler only.

The standard "52" and "56" crawlers are improved throughout. These improvements in general are typefied by the new Lorain-75 crawler, which is 12 per cent longer, 2300 lb. heavier, has a stronger, improved car-body casting, has 7x7 in. end axles, has 12 per cent increased tractive effort and has steering clutches mounted on splined shafts.

Complete details on the new center drive crawler are contained in a new booklet "The 52-56-64-68 tread center drive crawler," a copy of which may be had by addressing The Thew Shovel Co., Lorain, O.

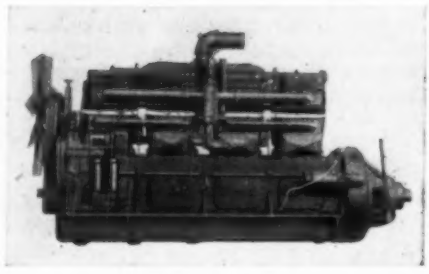
Climax Announces Another Blue Streak Motor

Carrying forward the policy of enlarging upon its field of activities the Climax Engineering Co., Clinton, Ia., has just announced the completion of its straight 8-6x7-in. valve in head motor. All of the outstanding characteristics of the Blue Streak Series are incorporated in this new model. Valving, spark plug location, and flame travel are controlled to secure low detonating values and unusually smooth operation with high power output.

The engine develops more than 200 hp. at 1,000 r.p.m. and 225 hp. at 1.200. The torque curve peaks at 600 r.p.m., giving approximately 1,145 lb.-ft. Flexiblity and lugging ability are remarkably apparent; the motor showing unusual "sweetness" and well developed "hanging on" characteristics. It will deliver 100 lb. B. M. E. P. at normal recommended speeds, and the fuel rate is under 0.6 lb. per b.hp. hour on gasoline.

This new model known as the RS1, is a triple fuel burning engine, handling distillate and natural gas with the relatively marked efficiency present during gasoline burning operation.

Force feed lubrication is employed, three oil pumps being provided to handle the lubricating oil from the end and main fuel supply pumps. A duplex



New Blue Streak Motor

oil filter is used, all oil being carefully filtered before going to the bearings. A special oil strainer is provided to clean the oil entering the overhead valve system.

Ample cooling is taken care of by an extra large centrifugal water pump. The water enters at the top of the cylinders, giving thermo syphon action in the jackets, passing up through the distributing parts in the head, around the spark plug, between the valve pockets and combustion chamber, to the water outlet manifold. An eight blade 36-in. fan with triple V-belt drive is incorporated in the design, with special mountings for tachometer, fuel pump, and other forms of accessory drive.

The motor is equipped with two 2-in. Zenith carburetors, governor, magneto and dual ignition. Two Leese Neville starting motors, one on each side of the engine, are used for starting purposes.

Burch Crack Filler

A recent development in the road field is a crack filler perfected by the Burch Corp., Crestline, O.

With this little machine one man can pour the heated tar or asphalt and follow with the sand or chips in the same operation, not only much faster but much better, it is claimed, than by the old method, as the chips adhere to the hot material and will not be picked up and carried away by the wheels of vehicles.

The compartment containing the hot material is fitted with a blowtorch that keeps the valve and pouring spout hot, and material will flow readily in cold weather.

Burch Crack Filler

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

Of Roads and Streets, published monthly at Chicago, Illinois, for April 1, 1930.

State of Illinois } ss.
County of Cook }

Before me, a notary public in and for the State and county aforesaid, personally appeared E. S. Gillette, who, having been duly sworn according to law, deposes and says that he is the business manager of the Roads and Streets and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Gillette Publishing Company, 221 E. 20th St., Chicago, Ill. Editor, H. P. Gillette, 221 E. 20th St., Chicago, Ill. Managing Editor, C. T. Murray, 221 E. 20th St., Chicago, Ill. Business Manager, E. S. Gillette, 221 E. 20th St., Chicago, Ill.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

Gillette Publishing Company, 221 E. 20th St., Chicago, Ill.; H. P. Gillette, 221 E. 20th St., Chicago, Ill.; E. S. Gillette, 221 E. 20th St., Chicago, Ill.; Mrs. R. W. Hume, 303 S. Stone Ave., LaGrange, Ill.; Winifred Gillette, 1125 Oak Grove Ave., San Marino, Calif.; Commonwealth Title Insurance & Trust Co., Chestnut and 12th Sts., Philadelphia, Pa.; Louise Forsythe, 13 E. Windermere Terrace, Lansdowne, Pa.; LaVerne Louer Hellyer, Ambassador Hotel, Chicago, Ill.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

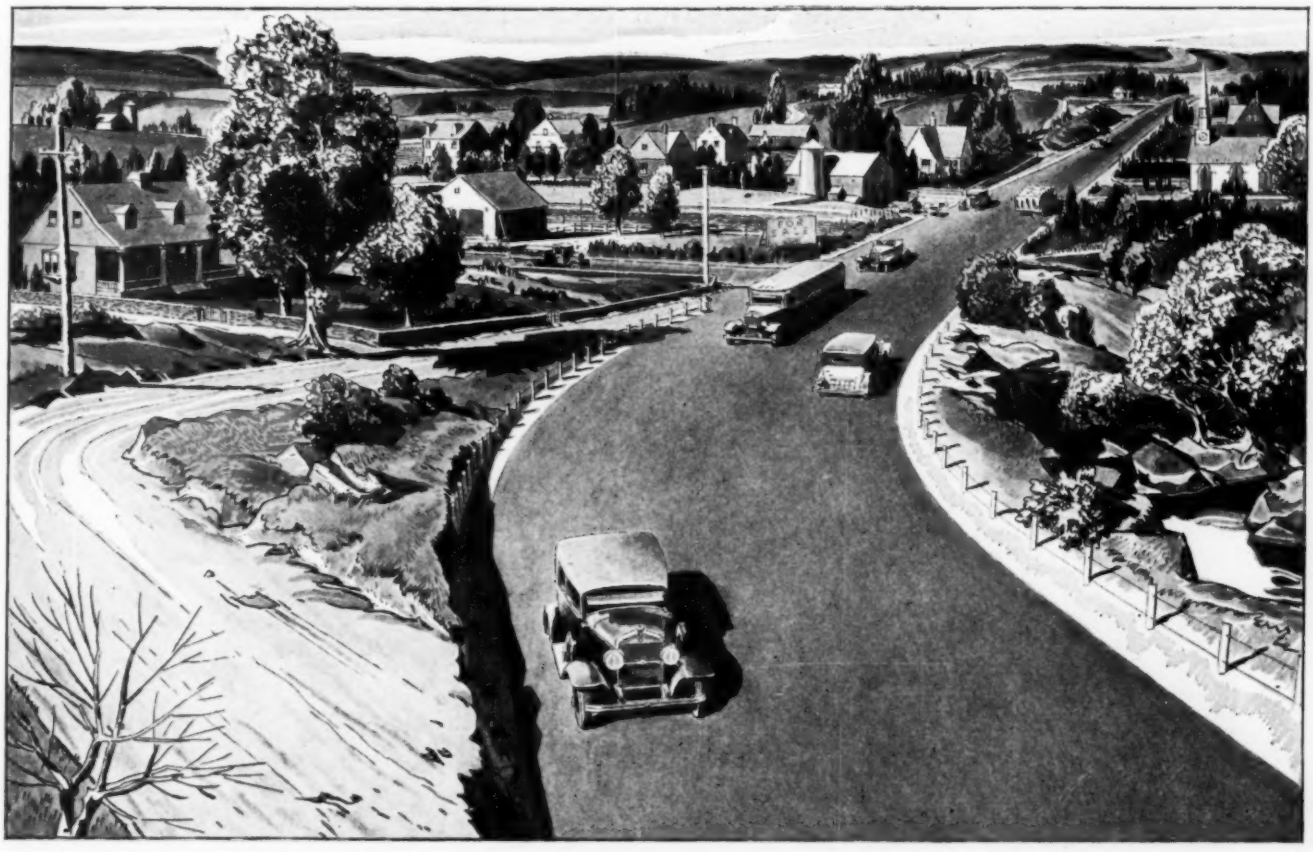
5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is: (This information is required from daily publications only.)

E. S. GILLETTE.
(Signature of business manager.)

Sworn to and subscribed before me this 21st day of March, 1930.

(Seal) KITTIE C. WOULFE.
Notary Public.
(My commission expires Feb. 8, 1934.)

No need to wait years *for this year's needs*



THIS year's needs are not a matter of pioneering new routes. Before we start blazing trails, let's *first improve what we have.*

The straightening, widening and modernizing of rambling, narrow, "buggy-gauge" roads will contribute untold relief to present conditions. Such a program is an assured means of making a little road-money do the work of a lot. When a community finally decides to meet *this year's needs this year,* it turns as a rule to the Tarvia organization for practical, money-saving cooperation.

Old gravel roads and broken down macadam can be salvaged by the Tarvia "Re-Tread" method—quickly, economically. No expensive machinery need be used to do a first-rate job, and with only the least expensive maintenance a "Re-Tread" pavement will last indefinitely—smooth, easy-riding, skid-safe and storm-proof.

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DISTRIBUTOR NEWS

The Distributor's Department in the Gillette Construction Group

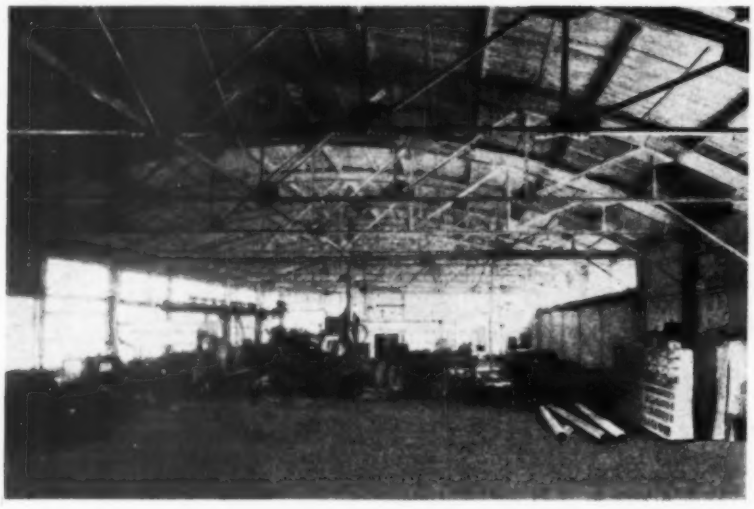
The Day & Maddock Co. Merge with Peden Equipment Co.

Announcement has been made of the merger of the Peden Equipment Co. and the Day & Maddock Co., effective April 1, 1930. It is stated that the personnel of both concerns is to be retained and will operate in the future as the Day & Maddock Co. from the plant and offices at 8201 Elmira Ave., S. W., Cleveland, O.

With the shop facilities for service and the additional sales organization under the merger, the new organization believes an ideal arrangement has been reached for complete and full contact with the trade over the territory covered. The merger places the Day & Maddock Co. among the leaders of the equipment dealers in the United States. Contractors and allied industries of Cleveland and vicinity are offered nationally known equipment together with complete rental and service facilities.

The officials of this company are all well known equipment men, including W. F. Maddock, W. T. Walsh, J. J. Moore, D. V. Peden and G. P. Williams.

Warehouse Headquarters of the Day & Maddock Company



Interior View of Day & Maddock Cleveland Plant

Budd Wheel Company, of Detroit, reports that service and replacement sales for February were 10.6 per cent above those for the corresponding month in 1929, and that the large volume of unfilled orders with which the month of March started indicates unprecedented earnings in this department.

W. H. Dutcher Made Purchasing Agent for Universal Atlas

Announcement has been made by Mr. B. F. Affleck, president of the Universal Atlas Cement Co., of the appointment of Mr. W. H. Dutcher as purchasing agent. For twenty-six years Mr. Dutcher has been connected with the Atlas Portland Cement Co., and the past twenty-four years he has served in the same capacity that he will now fill with Universal. The change has been brought about by the joining of the two companies under the name of the Universal Atlas Cement, a subsidiary of the United States Steel Corporation. Mr. Dutcher will be located in the Chicago headquarters of the company.

Prior to his connection with Atlas, Mr. Dutcher was in the New York offices of the Standard Oil Co. and then with Pratt & Lambert, manufacturers of varnishes and driers. He was at one time a governor of the Drug and Chemical Club of New York. He was also a member of the Purchasing Agents' Association of New York, as well as of the National Association.

Before his assignment to the Chicago office of Universal, Mr. Dutcher lived in Brooklyn, where he was a member of the Crescent Athletic Club and an associate member (son of a veteran) of Grant Post, G. A. R. He is also a member of the Holland Society, his ancestors having settled in New York in the 17th century.

O.K. Clutch Opens Office in New York City

Announcement has been received to the effect that the O.K. Clutch & Machinery Co. have opened an office at 55 W. 42nd St., New York City, under the management of Mr. R. B. Palmer, Jr. It is said that Mr. Palmer is well acquainted with hoisting machinery and compressors and will be able to assist customers in selecting the right equipment for their requirements.

Headquarters of this manufacturer are located at Columbia, Pa.

Chicago Pneumatic Tool Co., 6 E. 44th St., New York City, announces the opening of branch offices in the Perrine Bldg., Oklahoma City; 327 Philcade Bldg., Tulsa, Okla., and the Merchants and Manufacturers Bldg., Houston, Tex.

A Set of Blaw-Knox STEEL FORMS will build

Faster

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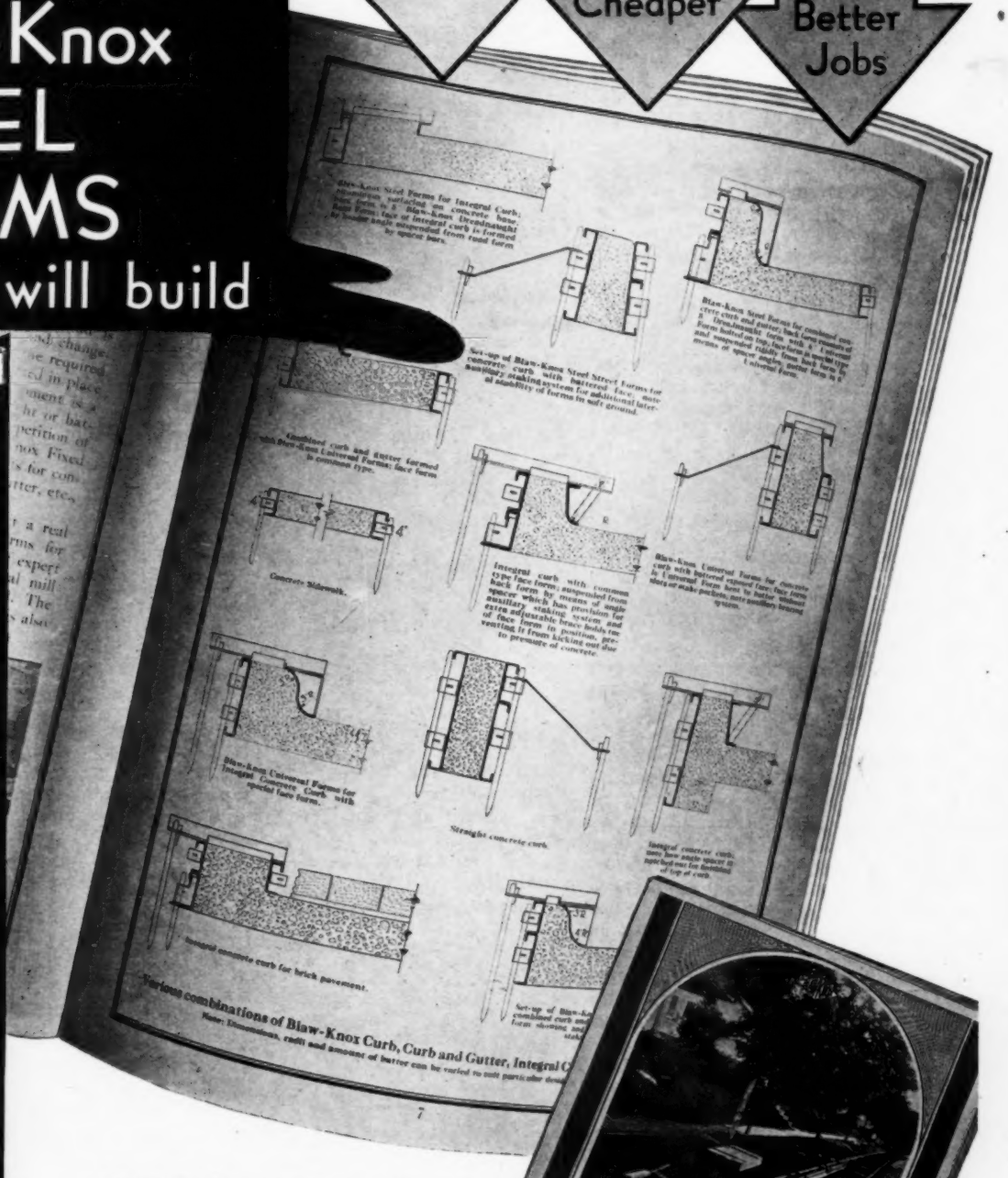
Better Jobs



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James E. Redman Makes Annual Coast Trip

On his annual trip to the western coast this year, Mr. James E. Redman, general sales manager of the automotive division of the American Bosch Magneto Corporation, will make arrangements for the distribution of his company's newest product—Bosch motor car radio. It is stated that the regular automotive and radio channels will be used to give the company a dual outlet for this product. Servicing and maintenance will be cared for by the chain of franchised Bosch automotive service stations, of which there are said to be over 2,000 in the country.

Mr. Redman reports both trade and consumer interest in this product to be growing daily. It has been exhibited in New York, Chicago, Boston and other eastern and mid-western points, and the most recent showing was at the Los Angeles Automobile Show.

A New Type of Budd Service

A new type of service for cars with Budd all-steel bodies is being established in all parts of the country by the specialized nation-wide chain of over 500 service stations recently organized by the Edward G. Budd Manufacturing Co. of Philadelphia and Detroit.

The new service, available to owners of cars with all-steel bodies, provides new doors without the usual delay of awaiting individual shipment from the factory after an accident in which door damage has been sustained.

According to a bulletin just issued by the Budd company, Scovel & Sons Co. of San Francisco has purchased 80 different styles of Budd all-steel doors, a complete assortment for all cars equipped with Budd bodies. Blumenthan Brothers of Chicago and the Abeles-Lewit Co. of New York have placed similar orders.

This means, acording to Budd officials, that any driver of an all-steel bodied car can obtain new doors from these dealers without delay, regardless of what make of Budd bodied car he is driving.

Hercules Motors Announces 1929 a Successful Year

In a recent report issued by the Hercules Motors Corporation of Canton, O., it is stated that the net earnings for 1929 are more than twice as great as those shown in 1928, which they attribute to greatly increased sales.

The information was contained in the annual report submitted to the stockholders by the president of the company, Mr. Charles Balough. Report stated that twice during the past year it was necessary to enlarge the manufacturing facilities, and 75,000 sq. ft. of floor space was added.

The officials state that they are looking forward to another prosperous year in 1930, and that the output for the first quarter of 1930 has shown a substantial increase over the same period for last year. Hercules Motors Corporation manufactures heavy-duty internal combustion engines.

When Six=One

Less than two years ago six large manufacturing companies were successfully operating six independent factories, each with its own group of officers and organization personnel. They had in common the fact that they were all located in the middle west and that they all served with their products the highway and construction contractor.

The Koehring Plant, Milwaukee

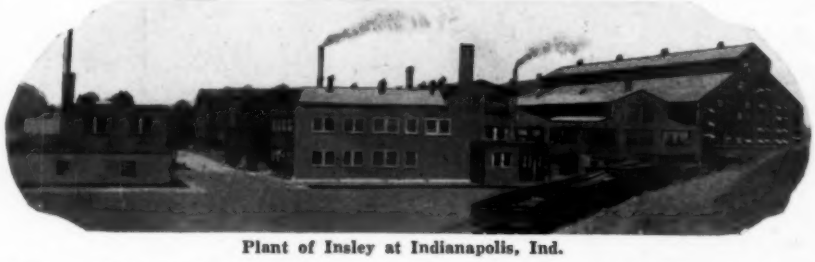
Abstractly speaking, factories seem like so much brick and mortar and machinery. But without the "works" there would be no factories, and always the "works" are men. So these men who operated these six factories were subject to the contagion which was being felt in all lines of business and mergeritis set in, affecting first four, then five and then all six of these companies, and from all reports, to fall back on the slang of the day, they put "the core in the National Equipment Corporation."

Just who are the manufacturers making up this "core" who evidently believe "In Union there is strength"—and also better service? First Kwik-Mix Concrete Mixer Co. of Port Washington, Wis., and T. L. Smith Co. of Milwaukee combined, and were then joined by the Koehring Co. of Milwaukee, Insley Manufacturing Co. of Indianapolis and the Parsons Co. of Newton, Ia.; and the sixth manufacturer to join this group was the C. H. & E. Manufacturing Co. of Milwaukee, who but recently became a member of the corporation.

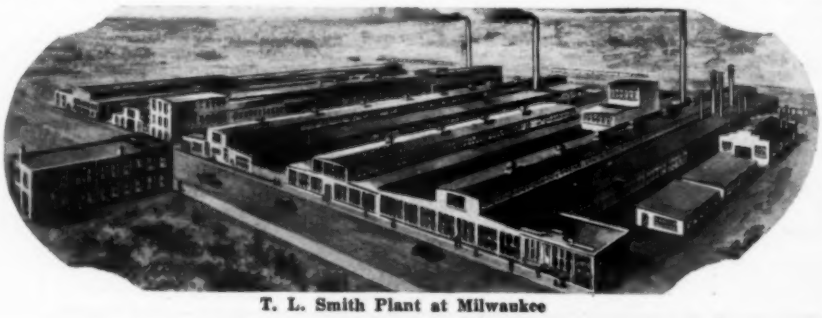
The products included in the output of the various plants are pavers, mixers, power shovels, excavators, concrete placing equipment, hoisting machinery, saw rigs, pumps, and many other necessary pieces of equipment to be used in the construction of skyscrapers and bridges, city streets and country roads, dams and reservoirs and other structural projects of this big building age.

In this great co-operative effort the driving force which sent these factories together was the desire on the part of the men responsible for them to better serve the users of their various products to whom they owed their success.

When the National Equipment Corporation was first formed it acted as a holding company, with each of the members maintaining separate man-

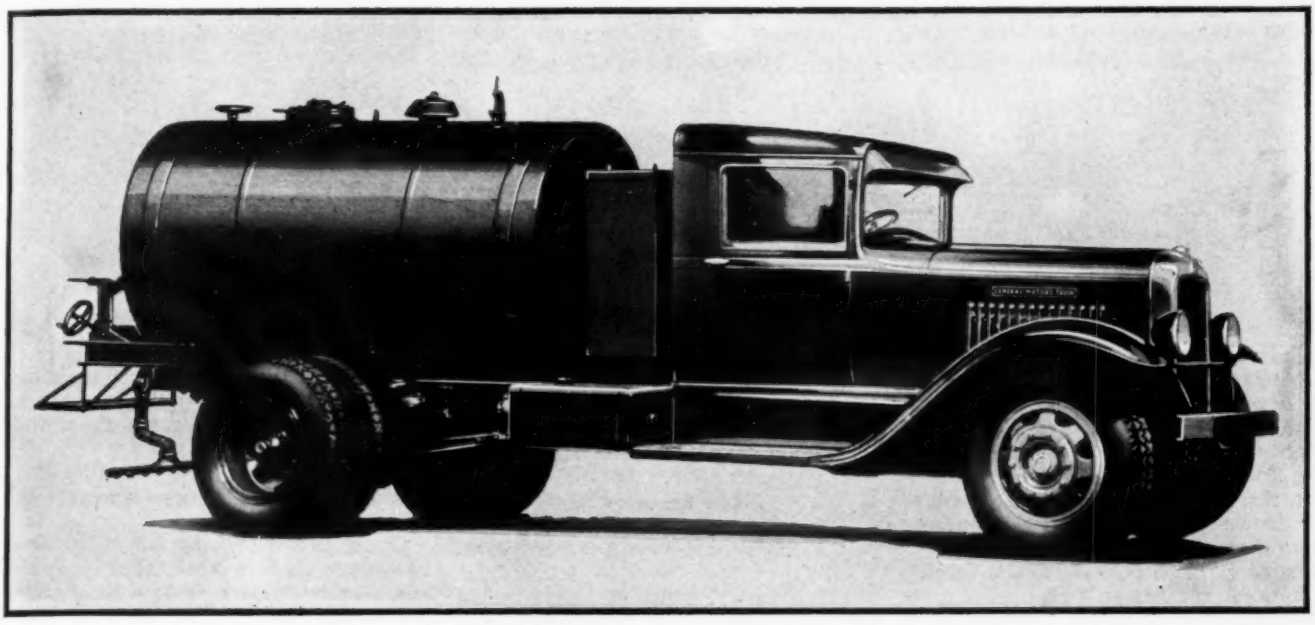


Plant of Insley at Indianapolis, Ind.



T. L. Smith Plant at Milwaukee

ITS BRUTE RUGGEDNESS MATCHES GIANT POWER!



$3985—4-TON RANGE

Model T-82B (Type 8203)—(Price, Chassis only, F. O. B. Pontiac, Mich.)

THIS SHOWS the Model T-82 in the 167½" wheelbase. Straight Rating 22,000 lbs. total gross weight, including load. This model is also available in 3 other wheelbases—155", 185¼" and 201"—and 12 different tire combinations.

AS A distributing unit for road surfacing—or in any other work where heavy tonnage has to be moved with day-in-day-out dependability—this truck has solidly established its dominance of the 4-ton range.

As a dump truck and as a tractor also—and on long hauls at sustained speed—this model has set records that promise to stand for some time.

A tremendous power and speed range is provided by the famed 6-cylinder engine—with five speeds forward and two in reverse. When the going gets tough—excavation pit, gumbo, or stiff grades—this truck will surge through with its load. Throughout its construction there is brute strength in perfect balance with its power and modern flexibility.

For such a big, rugged unit it is remarkably easy to steer and maneuver. Strong auxiliary springs provide easy riding through the entire load range. Giant 4-wheel brakes bring its 22,000 pounds (loaded) to a full stop—in a flash—when split seconds count.

Well up into the hundreds of thousands of miles you can count on this truck for modern, economical service.

Skimping on the purchase price of a heavy duty unit certainly isn't real economy. Because the *quality* that puts hard, tough strength into a truck like this costs money. But the unusual resources of General Motors Trucks in engineering, volume manufacturing and purchasing count heavily. *Combined*, these advantages have created a magnificent value.

It's a value worth seeing and investigating—*right now!*

GENERAL MOTORS TRUCKS

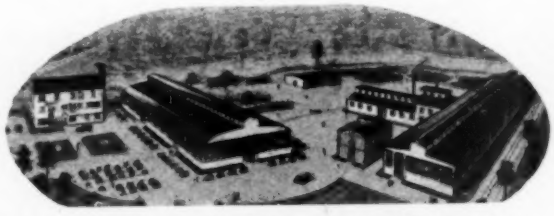
TIME PAYMENTS, on any General Motors Truck, are financed at lowest rates available anywhere, through our own Yellow Manufacturing Acceptance Corp.
GENERAL MOTORS TRUCK CO., Pontiac, Michigan (*Subsidiary of* Yellow Truck & Coach Mfg. Company) GENERAL MOTORS TRUCKS . . . YELLOW CABS . . . COACHES.
Factory Branches, Distributors, Dealers—in 1500 principal cities and towns.

A MODERN TRUCK FOR EVERY PURSE AND PURPOSE

agements. But this year, in order to carry out to the fullest measure possible, quality construction, better service and lower prices for the benefit of their patrons, they announced the fact that the corporation was now an operating company. This effected a coordination of business management, which according to their announcement, will result in production economies, elimination of experimental waste and savings effected through group buying.

Headquarters of the corporation are located at 31st St. and Concordia Ave., Milwaukee. Mr. Philip A. Koehring is president and treasurer. Mr. R. E. Brooks, for a number of years engaged in the equipment business in New York, was recently elected vice-president in charge of sales. Other officers serving the organization are W. H. Insley, vice-president; H. E. Smith, vice-president; H. C. McCardell, vice-president; W. J. Koehring, vice-president; F. F. Hase, vice-president; W. J. Zimmers, secretary; G. E. Long, controller, and C. A. Koehring, assistant treasurer.

C. H. & E. Manufacturing Co., Milwaukee



Plant of Kwik-Mix Concrete Mixer, Port Washington, Wis.

The Parsons Company, Newton, Ia.

However, operating as this company does, from one centralized board of management, they stress the fact that the same men who built up friendships among the users of their products when they were separate companies, maintain these same intimate man-to-man methods, but with the greater facilities at their disposal they are able to increase their service. Within the last few weeks a school for the training of the sales organization was conducted, making the rounds of the plants in order that the men representing these products might have first-hand and intimate knowledge of them. A nation-wide sales and service organization is maintained, with district warehouses for machines and parts located at strategic points.

Trade Practice Committee Adopts Set of Rules

Last fall a Trade Practice Conference was held under the auspices of the Federal Trade Commission and participated in by the manufacturers and representatives of the Associated Equipment Distributors and the Associated General Contractors of America, for the promotion of better business practices in the distribution of products of the concrete mixer and paver industry. This conference was in charge of E. A. McCulloch, chairman of the Federal Trade Commission, assisted by M. Markham Flannery, Director of Trade Practice Conferences.

A permanent Trade Practice Committee for the Concrete Mixer and Paver Industry, approved and accepted by the Federal Trade Commission, has been formed and is now functioning. The Committee has arranged to handle its work through its secretary, located at 630 Munsey Building, Washington, D. C. The members of the Committee are: C. G. Borchert, Borchert-Ingersoll, Inc., at St. Paul, Minn.; W. B. Knickerbocker, The Knickerbocker Co., Jackson, Mich.; Morton R. Hunter, Hunter Machinery Company, Milwaukee, Wis.; O. G. Mandt, The Jaeger Machine Company, Columbus, O.; A. P. Robinson, Ransome Concrete Machinery Company, Dunellen, N. J.; and C. S. Embrey, 630 Munsey Building, Washington, D. C. Mr. Robinson is chairman of the Committee and Mr. Embrey, secretary.

The Rules as approved by the Committee are aimed at such practices as misrepresentation of product, price discrimination, secret rebates, circulation of false statements and other unfair and unlawful trade practices. Through the permanent working committee, hope is expressed of obtaining widespread acceptance of the Rules and their observance. It is said that the Rules have been subscribed to by manufacturers and equipment distributors in large numbers throughout the country, and that hundreds of contractors have also subscribed to them in a voluntary effort to encourage the work.

Inquiries relating to the Rules may be addressed to the secretary of the Committee and pamphlets containing the Rules together with acceptance forms may also be secured from the secretary.

Chain Belt Takes Larger Quarters in New York

Chain Belt Company of Milwaukee has moved its New York Office into new and larger quarters. For a number of years their New York Office was located at 50 Church Street. The new quarters are in the new Chrysler Building, 405 Lexington, Ave., New York City.

The new office will give them a third more space than the old office and will be divided into a suite consisting of a reception room, file room, general office, conference room, salesmen's office and branch manager's office.

The New York Office not only looks after the Chain Belt Company's line of Rex products but also the products of the Stearns Conveyor Company of Cleveland, Ohio. The Stearns Conveyor Company is a division of Chain Belt Company.

Mr. W. H. Quinn is New York District Manager.

Budd Distributor Notes

W. S. Faulk, distributor for Budd wheels in Jacksonville, Fla., has discontinued all of his interests in the tire business and henceforth will devote his entire time to wheels and rims. Announcement has been made that Mr. Faulk has moved into larger quarters in the heart of the automobile section.

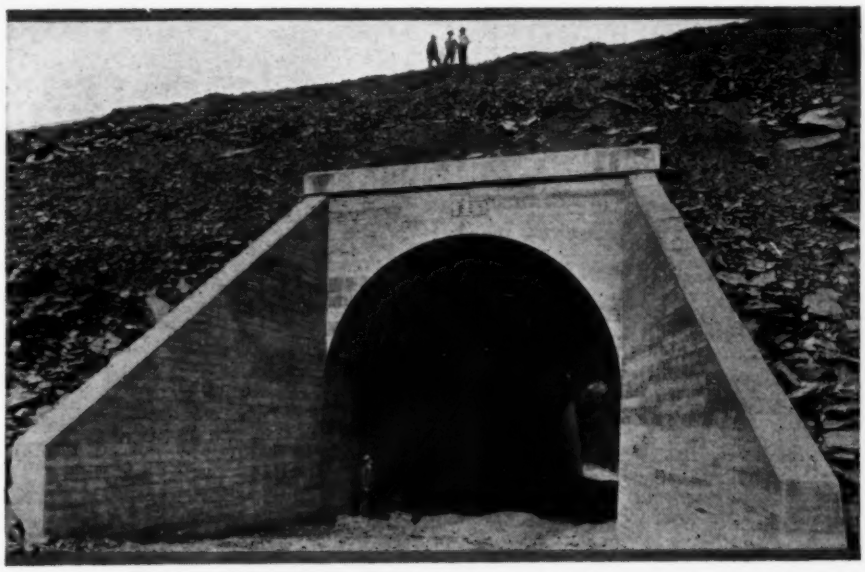
Announcement has also been made that at a recent meeting of the United Wheel and Rim Service, Inc., Philadelphia distributors for the Budd Company, Samuel Scott was re-elected president. New officers elected are James Kenyon, vice-president, and Ted Ominus, secretary and treasurer.

The Chain Belt Company of Milwaukee, Wisconsin, announces the appointment of the Corbin Supply Company of Macon, Georgia, as representatives for their complete line of chain and transmission equipment.

No segregation after a 12-mile haul

another tough concrete problem solved by the use of CELITE

Motor truck delivering concrete. You never have to pry a load of concrete containing Celite out of a truck.



About 2600 cubic yards of concrete were carried 9.2 miles to this 25 ft. concrete arch and were then chuted from top of the fill 100 ft. to the forms. Concrete was not mixed or agitated in transit.

ON the 17½ mile section of the Connellsville Extension of the P. & W. Va. Ry., Celite again has proved its ability to stabilize concrete on long hauls.

More than 30,000 cubic yards of concrete were poured on this job. All concrete was successfully transported by open body dump trucks operating on hauls from 2 to 12 miles from the central mixing plant at Monongahela. J-M Celite, added to the concrete mix, prevented segregation on these trips. The concrete was delivered at the forms as workable as when it left the mixer.

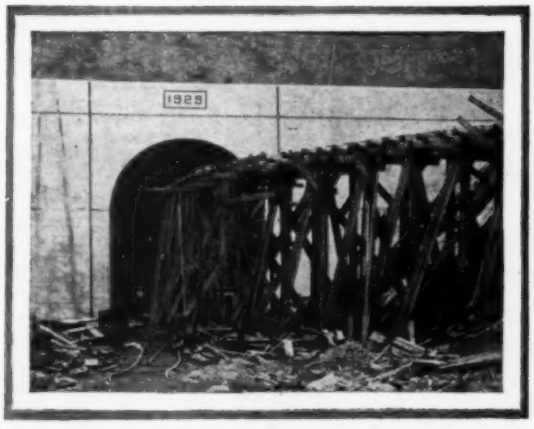
Mr. L. E. Goerder, General Supt. for the Vang Construction Co. of Pittsburgh, contractors on this job, makes the following comment: "When we started to haul concrete in regular trucks we had difficulty in getting it to slide out of the beds of the trucks. We tried adding 3% of Celite which we found to be just exactly what we wanted."

It is a simple matter to convince yourself that this experience of the Vang Construction Co. with Celite is not unusual.

Write us. We will gladly give you the names of a dozen or more prominent contractors and engineers who have used Celite to overcome what seemed like insurmountable difficulties in their concrete work. These men will tell you how "dry" concrete containing Celite has been chuted as far as 700 feet and placed as easily as if the mixer were right over the forms—how Celite by fattening the mix has increased the life of pipe bends 500% in concrete gun work—how the addition of Celite* has made it possible to pour slag concrete without honeycombing—how the increased yield of finished concrete alone has more than paid for the use of Celite.

Celite is not offered to you as a substitute for Portland Cement. Nor do we claim that Celite is a "cure-all" for concrete troubles. However, we know of no instance where Celite, properly used, has failed to increase workability, prevent segregation, increase watertightness and to improve the quality of the final concrete—more than enough to substantially repay its cost. Call in a J-M Concrete Engineer. Let him show you how to use this modern workability agent.

**Most concrete mixes require only 0.3 cubic feet of Celite per bag of cement.*



This tunnel 735 ft. long is lined and floored with concrete hauled 6½ miles from the central mixing plant. The excellent finish of the tunnel lining and portals is due to care both in the manufacture and placing of the concrete—and to the use of Celite.

JOHNS-MANVILLE PRODUCTS

Johns-Manville

CELITE FOR CONCRETE

Makes Better Concrete at Less Cost

Address JOHNS-MANVILLE
At nearest office listed below
New York Chicago Cleveland San Francisco Toronto
(*Offices in all large cities*)

- ☐ Please have a J-M Concrete Engineer call.
- ☐ Please send me a copy of your Celite for Concrete Booklet—CC-1-A-1.

Name.....

CC-127-5

Address.....

Universal Atlas Announces Executive Appointments

Appointments in the offices of the secretary and the treasurer of the Universal Atlas Cement company, a subsidiary of the United States Steel corporation were made public today by B. F. Affleck, president of the company. The new company was formed this year by the union of the Atlas and the Universal organizations.

Richard B. Hynes, formerly assistant secretary and assistant treasurer of the Atlas Portland Cement company, has been appointed secretary of the new Universal Atlas company. Mr. Hynes was in the secretary's department of the former Atlas organization since 1916. Since 1925 he was assistant secretary and assistant treasurer of both the Atlas Portland Cement company and of its subsidiary, the Atlas Gypsum corporation. "From his fourteen years' connection with the department of the secretary of the Atlas company, Mr. Hynes brings to his new position wide experience and familiarity with secretarial functions that assure efficiency in his new office," Mr. Affleck said. Mr. Hynes will be located at the Universal Atlas headquarters in Chicago.

Born and reared in Chicago, T. E. O'Connor of New York, appointed treasurer of the Universal Atlas Cement company, will be returning to his home city when he takes up his new duties. Previously western credit manager for the former Atlas company with offices in Chicago, Mr. O'Connor in 1924 was called to the executive offices of the company in New York and assigned to the treasury department. Mr. O'Connor was connected with Atlas for thirteen years beginning as assistant to the western credit manager to which position he later was promoted.

A. J. Joyce, formerly assistant credit manager of the Universal company and now appointed assistant treasurer at Chicago for the Universal Atlas Company, has had 23 years' experience in this field. He was connected with Universal for 14 years and with the Illinois Steel Company and the Illinois Steel Warehouse Company, two other subsidiaries of the Steel Corporation, for seven and two years respectively, He installed the credit department at the north works of the Illinois Steel Company and at the St. Paul office of the Illinois Steel Warehouse Company.

E. M. Johnson, for twelve years eastern credit manager of the former Universal company and now named assistant treasurer at Pittsburgh of the new company, was connected with the former Universal company for 23 years. Previously he spent several years with the Illinois Steel Company, another corporation subsidiary, and other companies in various positions. Before his appointment as eastern credit manager, Mr. Johnson was assistant credit manager at the company's main office in Chicago.

J. L. Medler, member of the former Atlas organization for 28 years and its assistant treasurer since 1911, is named assistant treasurer at New York of the Universal Atlas Company. For two years he was president of the New York Credit Men's Association and for four years was treasuer of the Crescent Athletic Club in Brooklyn, where he resides. Prior to joining the former Atlas company in 1901, he was connected with the Central Railroad of New Jersey. In addition to his high school and collegiate education, he received a master's degree in law and was admitted to the bar of the State of New York.

Manitowoc Engineering Adds New Distributors

The following distributors will handle Moore speedcranes, shovels, draglines and trenchoes in their various territories, for the Manitowoc Engineering Works, whose plant is located at Manitowoc, Wis.:

Edgerton & Sons Co., 585 Hosatonic Ave., Bridgeport, Conn.; Hudson Valley Welding Co., 7 Buckingham Ave., Poughkeepsie, N. Y.; W. A. Ward, Hillsdale, N. Y.; James Beale, Jr., Box 445, Sound Berch, Conn.; Ilium Truck & Equipment Co., Inc., 2 Oakwood Ave., Troy, N. Y.; Contractors Machinery Co., Kansas City, Mo.; J. B. Harbison Equipment Co., Little Rock, Ark.; Northfield Iron Co., Northfield, Minn.; J. C. McDonald, 2104 Webster St., Omaha, Neb.; Contractors Machinery & Supply Co., 318 Penn Ave., Pittsburgh, Pa.; LaLance Equipment Co., Huntington, W. Va.; Richmond Machinery Co., Richmond, Va.; J. W. Hodge, 1334 N. Highland Ave., Atlanta, Ga.; Harvard Turnbull & Co., Excelsior Life Building, Toronto, Ont.

Timken Elects Officials

At the annual shareholders meeting of The Timken Roller Bearing Company recently directors elected were H. H. Timken, J. G. Obermier, M. T. Lothrop, J. W. Spray, Henry H. Timken, Jr., of Canton; W. R. Timken of New York and A. C. Ernst of Cleveland. Officers elected at the directors meeting were H. H. Timken, Chairman; M. T. Lothrop, President; W. R. Timken, J. G. Obermier, J. W. Spray, H. J. Porter, T. V. Buckwalter, L. M. Klinedinst, Vice Presidents; R. C. Brower, Secretary-Treasurer; J. A. Riley, Assistant Treasurer; F. F. Tudor, Assistant Secretary.

D. J. Wilber Transferred to New York

Robert Bosch Magneto Company, Inc., announces the appointment of Mr. D. J. Wilber as Manager Trade Sales, Department "S," with headquarters at the main offices, Long Island City, New York. For the present Mr. Wilber will devote the major part of his time to the introduction of the new Robert Bosch "Semaphore"—a direction indicator for motor vehicles, for which it is said an increasingly heavy demand is being experienced.

Before his present appointment, Mr. Wilber was the Robert Bosch district representative for the state of Michigan and the Province of Ontario.

Trackson Distributor Notes

The Trackson Co., 500 Clinton St., Milwaukee, Wis., announces the appointment of the Concrete Machinery & Supply Co., 777 E. Merrill Ave., Los Angeles, Calif., as distributors of Trackson tractor equipment for the McCormick-Deering tractor.

This company will cover the Los Angeles territory and, according to announcement, will be in a position to give prompt service on all orders for machines, as well as for repair and replacement parts.

Distributor Notes from Chain Belt

Chain Belt Company of Milwaukee, Wis., have recently announced the appointment of the R. B. Everett Company of Houston, Texas, as distributors for their complete line of Rex construction equipment, including Rex Saw Rigs, Rex Plaster and Mortar Mixers, Rex Pumps—Self-Priming Centrifugals, Diaphragms, Centrifugals and Road Pumps. Also Concrete Mixers, Pavers, Contractors Elevators, etc.

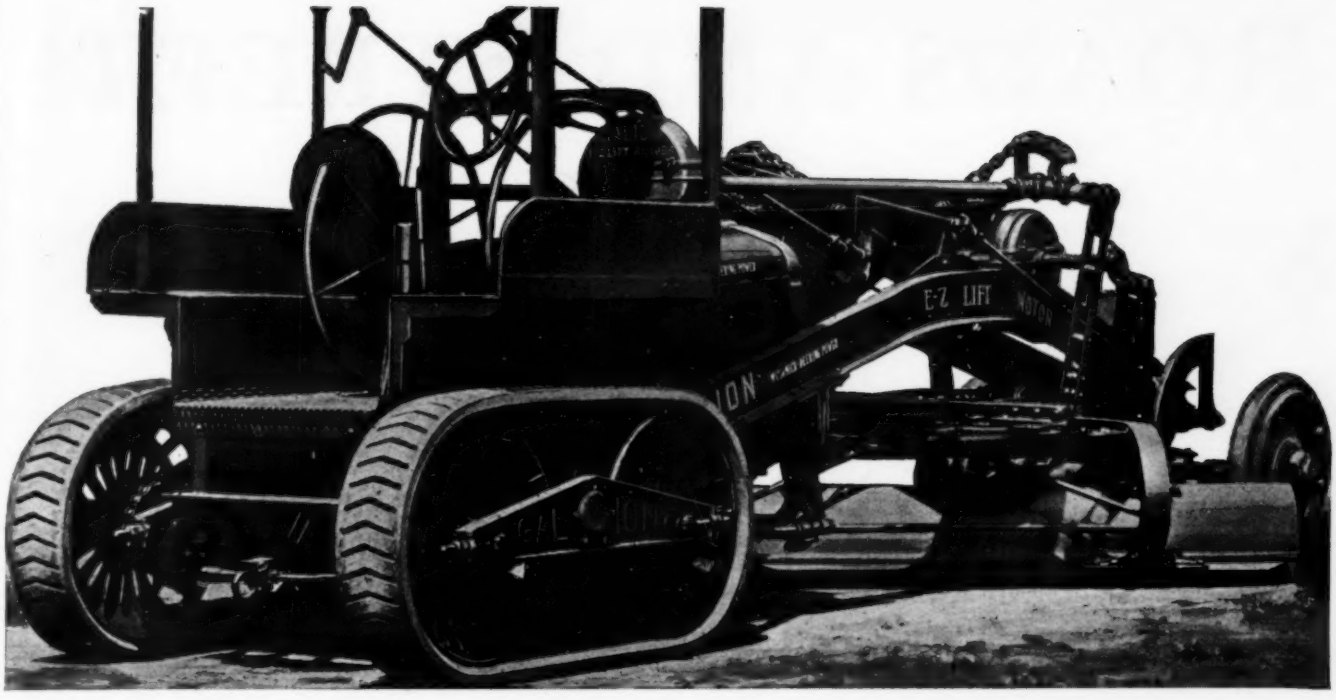
J. D. Adams Company of Indianapolis, Ind., has been made exclusive distributors in the Indianapolis territory for the new champion Rex paver and its companion, the Rex road pump.

Gardner Denver Agent Goes to Chili

Ian Duncan, formerly of Glasgow, Scotland, sailed recently for Santiago, Chili, where he will represent the Gardner-Denver Co., in the mining districts of that country. His headquarters will be with Spencer & Waters, Ltd., Chilean agents for Gardner-Denver. Duncan recently finished special courses offered in the Quincy plant of the company. It was Mr. Duncan's original intention to represent this company in London.

The Stearns Conveyor Company, Cleveland, a division of Chain Belt Company, Milwaukee, has recently completed a catalog and engineering data book containing complete and specialized information on the designs and application of Rex-Stearns Timken Idlers for all types of belt conveyors, together with allied and auxiliary equipment necessary for complete belt conveyor installations.

The book also covers information on Rex-Stearns Glass Plant systems and Rex-Stearns Silo Storage Systems.



Sure-trac Rubber Crawler

An Exclusive Feature on .....
Galion E-Z Lift Motor Graders

Again Galion sets the pace with another new development in Motor Grader construction, the Galion Sure-Trac Rubber Crawler. A few of its outstanding advantages are: smooth continuous track with positive traction under all working conditions --- greater operating economy --- less vibration --- higher speed and guaranteed mileage.

Objectionable features found in steel crawlers are eliminated entirely. Sand, which sets up a grinding action between the sprockets and steel plates of metal crawlers, causing great wear, does not affect the rubber crawler, as there are no links or sprocket teeth.

Destructive vibration, caused by flopping action of the metal links or plates as they lay themselves on the ground, is replaced by the smooth, cushioned surface of the rubber track. Gripping action of rubber easily carries the crawler over large stones or rough soil and the drop is made without shock to the machine.

A higher operating speed of the tractor may be maintained---rubber track is designed and constructed to stand up under a much higher speed than any steel crawler ever designed.

More detailed information on the Gallion McCormick-Deering E-Z Lift Motor Grader will be sent on request.

Galion Distributors

W. A. Adams Tractor & Equip. Co., Raleigh, N. C.
R. S. Armstrong & Bro. Co., Atlanta, Ga.
O. B. Avery Co., St. Louis, Mo.
Badger Tractor & Equip. Co., Milwaukee, Wis.
W. D. Banker Road Machy. Co., Memphis, Tenn.
Banks-Miller Supply Co., Huntington, W. Va.
Borchert-Ingersoll, Inc., St. Paul, Minn.
Brown-Fraser & Co., Ltd., Vancouver, B. C.
Dukehart Machy Co., Des Moines, Iowa
Eastern Tractor Co., Cambridge, Mass.
Feenaughty Machy. Co., Portland, Ore.
Frankfort Equip. Co., Frankfort, Ky.
Good Roads Machy Co., Inc., New York, N. Y.
Hall Perry Machy. Co., Butte, Mont.
Herd Equip. Co., Oklahoma City, Okla.
Interstate Machy. & Supply Co., Omaha, Nebr.
Jeffrey Mfg. Co. Ltd., Montreal, Que.
Jenison Machy. Co., San Francisco, Cal.
C. H. Jones Co., Salt Lake City, Utah.
Lewis-Patten Co., San Antonio, Texas.
Lewis Tractor & Machinery Co., Fargo, N. D.
Miller & Requarth, Springfield, Ill.
Morrow Auto Co., Albuquerque, New Mexico
H. W. Moore Equip. Co., Denver, Colo.
Morrisey Easton Tractor Co., Vicksburg, Miss.
Murphy & Murphy, Little Rock, Ark.
C. T. Patterson Co. Inc., New Orleans, La.
G. C. Phillips Tractor Co. Inc., Birmingham, Ala.
Power Equip. & Service Co., New Haven, Conn.
F. Ronstadt Co., Tuscon, Ariz.
Salina Tractor & Thresher Co., Salina, Kan.
Bert Smith, Enid, Okla.
Smith-Booth-Usher Co., Los Angeles, Cal.
Standard Road Equip. Co., Rockford, Ill.
W. H. Stoutenburg, Penn Yan, N. Y.
Tennessee Tractor Co., Nashville, Tenn.
F. E. Vaughn, LaCrosse, Kan.
Virginia Road Machy. Co., Richmond, Va.
Welch Good Roads Supply Co., Welch, W. Va.

The Galion Iron Works & Mfg. Co.

Galion - - - - - - - - - - Ohio

ROADS AND STREETS

H. P. Gillette Editor

Vol. LXX JUNE, 1930 No. 6

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